



## A Comparative Analysis of Biowaste Management in Five European Clusters

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# EUBCE 2018

26<sup>TH</sup> EUROPEAN BIOMASS CONFERENCE & EXHIBITION

14 - 17 MAY CONFERENCE & EXHIBITION | 18 MAY TECHNICAL TOURS

COPENHAGEN - DENMARK  
BELLA CENTER

## BOOK OF ABSTRACTS SUMMARIES







# EUBCE 2018

## 26<sup>TH</sup> EUROPEAN BIOMASS CONFERENCE & EXHIBITION

### 14 - 17 MAY CONFERENCE & EXHIBITION | 18 MAY TECHNICAL TOURS

COPENHAGEN - DENMARK  
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## Conference Programme / Outline of the week

	Monday, 14 May	Tuesday, 15 May	Wednesday, 16 May	Thursday, 17 May	Friday, 18 May
09:00	Plenary Session "Applications of Science in Industry"	1BO.1 T1.2	1CO.1 T1.4	2DO.1 T2.6	TECHNICAL TOURS
	High Level Opening	2BO.2 T2.4	4CO.2 T4.1	4DO.2 T4.4	
	Moderated Panel "The Vital Role of Biomass for Climate Protection and Sustainable Development"	3BO.3 T3.6	3CO.3 T3.1	3DO.3 T3.2	
12:35	Lunch Break	5BO.4 T5.1	5CO.4 T5.2	1DV.1 T1.2	
13:30	1AO.1 T1.1	IBV.1 I6.2/6.3 6.4	ICV.1 I6.1/6.5	2DV.2 T2.1	
15:00	2AO.2 T2.2	3BV.2 T3.7	2CV.2 T2.4		
15:15	3AO.3 T3.4	Break	Break	2DO.4 T2.6	
16:45	4AV.1 T4.6	10:15 Plenary Session "Climate and Sustainability"	10:15 Plenary Session "Innovation and Integration"	4DO.5 T4.3	
17:00	1AV.2 T1.5	12:30 Lunch Break	12:30 Lunch Break	3DO.6 T3.2	
18:30	2AO.5 T2.2	13:30 Lunch Break	13:30 Lunch Break	1DV.3 T1.2	
	3AO.6 T3.6	1BO.5 T1.2	1CO.5 T1.3	3DO.9 T3.3	
	4AV.3 T4.2	2BO.6 T2.4	4CO.6 T4.5	4DO.8 T4.3	
	3AV.4 T3.4	3BO.7 T3.7	3CO.7 T3.5	1DV.5 T1.3	
	Break	IBO.8 T6.5	ICO.8 T6.2	3DV.6 T3.1	
	1AO.4 T1.1	5BV.3 T5.1/5.2	3CV.3 T3.2		
	2AO.8 T2.3	2BV.4 T2.2/2.3	2CV.4 T2.5		
	3AO.9 T3.6	1BO.9 T1.6	1CO.9 T1.3		
	3AV.5 T3.7	2BO.10 T2.5	4CO.10 T4.2		
	4AV.6 T4.1/4.4/ 4.5	3BO.11 T3.7	3CO.11 T3.5		
		IBO.12 T6.4	ICO.12 T6.1		
		3BV.5 T3.6	2CV.5 T2.6		
		4BV.6 T4.3	3CV.6 T3.3		
		Break	Break		
		1BO.13 T1.5	2CO.13 T2.1		
		2BO.14 T2.5	4CO.14 T4.2		
		4BO.15 T4.6	3CO.15 T3.2		
		IBO.16 T6.3	ICO.16 T6.1		
		3BV.7 T3.6	2CV.7 T2.6		
		1BV.8 T1.4/1.6	1CV.8 T1.1		
				Conference Closing	

Welcome Reception

EUBCE Dinner

Topics / Subtopics

### 1 Biomass Resources

- T1.1 Biomass potentials and biomass mobilisation
- T1.2 Biomass feedstock, residues and by-products
- T1.3 Biomass crops and energy grasses
- T1.4 Algae production systems
- T1.5 Municipal and industrial wastes
- T1.6 Integrated biomass production for energy purposes

### 2 Biomass Conversion Technologies for Heating, Cooling and Electricity

- T2.1 Production and supply of solid biofuels
- T2.2 Biomass and bioliquids combustion for small and medium scale applications
- T2.3 Biomass combustion in large utilities
- T2.4 Gasification for power, CHP and polygeneration
- T2.5 Gasification for synthesis gas production
- T2.6 Anaerobic digestion for biogas production and biogas upgrading

### 3 Biomass Conversion Technologies for Fuels, Chemicals and Materials

- T3.1 Production of thermally treated solid biofuels
- T3.2 Pyrolysis
- T3.3 Biomass hydrothermal liquefaction
- T3.4 Oil-based biofuels
- T3.5 Bio-alcohols from lignocellulosic biomass and pretreatment
- T3.6 Biorefineries
- T3.7 Production and application of biobased chemicals

### 4 Biomass Policies, Markets and Sustainability

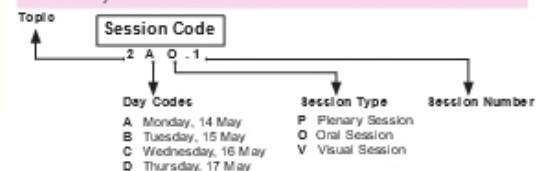
- T4.1 Market implementation, investments & financing
- T4.2 Sustainability and socio-economic aspects
- T4.3 Environmental impacts of bioenergy
- T4.4 Climate impacts of bioenergy
- T4.5 Resource efficient bioeconomy
- T4.6 Biomass strategies and policies

### 5 Bioenergy Integration in Energy Systems

- T5.1 Strategies for bioenergy integration into energy systems
- T5.2 Technological options for energy grid balancing

### 6 Industry Sessions

- T6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)
- T6.2 Thermochemical conversion processes
- T6.3 Power & Heat processes and systems
- T6.4 Biochemical conversion
- T6.5 Policy



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## **Consolidating the Current Knowledge Base of the Quantitative Biomass Potentials for European Energy Supply**

Short introductive summary:

Projections of the feasible domestic supply and demand for biomass-derived energy and heat range widely for Europe in the mid- to long-term. In order to provide conversant insight towards the role of the bioenergy and its scale for the region, it is vital to gain an overview of existing projections and realise the causes of variability. A firm, quantitative understanding of the total domestic and imported biomass utilised in the EU affords an array of benefits, from decision-making at the local level, to aiding in defining improved macro-scale, time-bound targets on bioenergy obligations. More specifically this study reviews and analyses biomass potentials from (i) recent policy documentation covering the EU region and at national level; (ii) resource- & demand-based bottom up assessments; (iii) projections from leading integrated assessment models under harmonised scenarios.

Presenter: **Steven MANDLEY, Utrecht University, Energy & Resources, Utrecht, THE NETHERLANDS**

Presenter's biography:

Steven Mandley, MSc in Sustainable Development (energy & Resources), holds a position as PhD candidate at Utrecht University(NL). The focus of his research is surrounding the development of the biobased economy in the EU region.

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Session reference: 1AO.1.1

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

**Estimation and Geographic Distribution of Marginal Agricultural Lands in Spain with Bioenergy Potential**

Short introductive summary:

The term marginal land is usually referred to lands with biophysical constraints and with low economic competitiveness where farm margin of existing traditional agriculture has been below production costs. In Spain there are around 17 million ha of crop land of which 10 million are rain-fed herbaceous crops land (80% winter cereals). Biophysics factors like soil low organic matter content, low water retention and adverse climate conditions determine low crop yield and, in conjunction with economic output/input farm ratios, the agricultural production profitability of one area. The purpose is to identify areas where traditional food crops are not sustainable economically and could be substituted by others for industrial use. The identified marginal areas are georeferenced using the software ArcGIS. The results obtained indicate that the arable land estimates marginal is about 2 million hectares, which is about 4% of the total Spanish surface. This data shows the valuable objective of this work, identifying the areas in risk of abandonment in order to enhance them. This methodology can be a step ahead in the development of tools for identification of marginal lands.

Presenter: **Carlos Sixto CIRIA RAMOS, CIEMAT, Biomasa Dpt., Lubia (Soria), SPAIN**

Presenter's biography:

Agricultural Engineer at Lérida University. PhD researcher in Energy Department of Centre for Energetic Environmental and Technological Research (CIEMAT), Biomass Unit in the Centre for the Development of Renewable Energy Sources (CEDER). Research activity is close to biomass production, economic,

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Session reference: 1AO.1.2

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES



## **Modelling the Potential Bioenergy Production from Agro-Forestry Crops and Residues in Angola**

Short introductive summary:

Biomass is the major energy source in Angola contributing to 65% of the country's primary energy supply and 80% of Angolans rely on biomass for most of their energy needs, especially in rural areas. Nevertheless, in Angola, only 30% of the population has access to electricity, although Angola has extensive hydroelectric power resources that far exceed its present needs and crude oil production in Angola ranks second in sub-Saharan Africa. An assessment of the biomass resources potential for bioenergy in the province of Huíla, in Angola, is being conducted. More specifically, in the project, the amount and types of sustainable agroforest residues and dedicated crops to energy and their provincial distribution is being determined. The preliminary analysis to the data shows that circa 500 000 tonnes of agroforest biomass could be collected and transformed into heat or energy carriers, such as bioethanol, biobutanol, biodiesel, biogas and biohydrogen. The characteristics of the different agroforest residues are presented in the study and different scenarios for the exploitation of this biomass are taken into account.

Presenter: **Fernando CATIVA, Faculdade de Ciências e Tecnologia, UNL, Departamento de Ciências e Tecnologia da Biomassa, Caparica, PORTUGAL**

Presenter's biography:

PhD student in Bioenergy at Universidade NOVA de Lisboa

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Session reference: 1AO.1.3

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

**Potential Effects of Global Warming on the Spatial Distribution and Productivity of Five Tree Species Used in the Wood Energy Supply Chain in France for 2050**

Short introductive summary:

The use of wood biomass for energy systems, in order to produce heat and/or electricity, represents around 40% of the amount of renewable energy production in France. More than 6,000 wood-energy installations have been created in France since the beginning of the 2000s for the collective and industrial energy production. The availability of the wood resource for the short and mid-term is a key point to ensure the sustainability of combustion systems that are built for a minimum life service of 25 to 30 years.

We propose here to assess the potential impact of climate change on the vegetation dynamics of five wood species and the Net Primary Productivity (NPP) variation towards 2050. This prospective approach aims to assess the sustainability of the wood energy sector at the scale of France. The results show a significant reduction of the probability of occurrence of the most suitable areas for the development of *Fagus silvatica* L. (beech) in France towards 2050. The results also underline that the wood resource located in plains and low altitude may produce less biomass in 2050 than currently, which could affect the dynamic of the wood supply chain.

Presenter: **Emmanuel GARBOLINO, Mines Paris-tech, CRC - Centre de Recherche sur les Risques et les Crises, Sophia Antipolis, FRANCE**

Presenter's biography:

Emmanuel Garbolino is an Assistant Professor, expert in the assessment of risk induced by climate change on ecosystems and society. He has a scientific background in ecology (Master degree) and in geography (PhD and Accreditation to supervise research - HDR).

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Session reference: 1AO.1.4

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

## **Impacts of Climate Change on Regional Bioenergy Feedstock Availabilities**

Short introductive summary:

Bioenergy is expected to play a vital role in energy sector decarbonisation. Much discussion has centred on land and water resource competition for bioenergy agriculture, however future resource availabilities are also affected by the impacts of climate change on agricultural yields. This study assesses impacts of climate change on regional crop feedstock availabilities in the context of future land-use scenarios combining food requirements, urban expansion and conservation. Results of a gridded fuzzy-logic crop land suitability model and agricultural yields from literature are combined with a set of land availability masks to determine future regional feedstock availabilities for scenarios of climate change, biodiversity conservation and a number of socio-economic development pathways.

Presenter: **Jennifer CRONIN, UCL, Energy Institute, LONDON, UNITED KINGDOM**

Presenter's biography:

I graduated in 2010 with an MPhys in Physics, then worked for five years in renewable energy project development. I am now in the third year of my PhD at the UCL Energy Institute, studying impacts of climate on bioenergy resources and their role in long-term energy system decarbonisation.

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Session reference: 1AO.1.5

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

**Co-Firing of Pelletized Cassava Rhizome and Eucalyptus Bark in a Fluidized Bed: Studies on the Effects of Co-Firing Methods and Bed Material Type on the Combustor Performance and Time-Related Bed Behavior**

Short introductive summary:

Cassava rhizome and eucalyptus bark are promising bioenergy resources in Thailand, both exhibiting a great energy potential. However, elevated fuel-N and substantial proportion of potassium in cassava rhizome, as well as very high moisture content in eucalyptus bark, make individual burning of these biomasses in direct combustion systems to be problematic or even not feasible. In this work, the two biomasses were co-fired in a fluidized-bed combustor using fuel staging and reburning methods, and alternative bed materials, to remediate the above-mentioned operational problems. Both co-firing methods were found to affect the combustion and emission performances of the reactor, as well as the bed physiochemical characteristics. Through the co-firing, NO emission from the reactor can be noticeably reduced compared to firing pure cassava rhizome (a base fuel), the greater NO reduction being obtained when using a reburning. With alternative bed materials (alumina sand or mixture of alumina and silica sand), the bed agglomeration tendency in the reactor can be substantially reduced, compared to co-firing the selected fuels in a bed of pure silica sand, ensuring a safe operation

Presenter: **Vladimir KUPRIANOV, Thammasat University, Sirindhorn International Institute of Technology, Pathum Thani, THAILAND**

Presenter's biography:

Prof. Vladimir Kuprianov received his doctoral degree from Moscow Power Engineering Institute. His research expertise is related to combustion and emission control in fossil fuel-fired boilers and biomass-fuelled fluidized-bed systems.

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Session reference: 2AO.2.1

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Utilization of Various Non-Woody Biomass Fuels in an Innovative Multi-Fuel Combustion Concept**

Short introductive summary:

The efficient exploitation of resources, also of renewable energies, is important for the climate and the reliability of supply. Particularly in Austria biomass fuels significantly contribute to energy supply. Within the wide range of biomass raw materials, fuel properties can vary widely and thus considerably affect the combustion behavior in small-scale appliances in terms of slagging behavior, efficiency, or the release of particulate matter as well as nitrogen oxide emissions. Since it is no option to develop technologies for particular fuels, technologies need to be flexibly adjustable to different fuel qualities. In this work, combustion tests were conducted utilizing a wide range of biomass fuels (e.g. short rotation coppice, miscanthus, bamboo, corncobs, hay, grain mill residues) in an innovative combustion concept (i.e. the patented screw burner technology). Results showed a significant influence of particular technological aspects on the applicability of different biomass fuels.

Presenter: **Sabine FELDMEIER, Bioenergy 2020+, Graz, AUSTRIA**

Presenter's biography:

Research Associate since 2010:

2010 - 2011: Biomass gasification (characterization of fuels and residues, practical lab tests, field tests)

2012 - now: Small-scale biomass combustion (practical tests, data evaluation)

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Session reference: 2AO.2.2

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Characterisation, Testing and Modelling of a Variety of Pulverised Biomass Fuels Burnt in an Axially Air Staged Swirl-Stabilised Test Burner for an Industrial Heating Application**

Short introductive summary:

An air staged, swirl-stabilised, test burner was developed to investigate pulverised solid fuel combustion for industrial heating. In parallel, a CFD model was set up and validated to support the design and optimisation of new test burners and to aid in the interpretation of results. This model evolved from an Eulerian/Lagrangian model developed to predict pulverised coal combustion. A detailed characterisation of fuel properties was carried out using a variety of methods on a number of different types of pulverised biomass fuels including hard and soft woods, waste material from lumber mills, urban tree trimmings, etc. Several of these biomass fuels were pre-treated using torrefaction. Testing was performed, including a variation of air to fuel ratio and air flow split between the primary and secondary air stages. Predicted NO<sub>x</sub> emissions agreed well with measured values. CO emissions were found to be significantly underpredicted, but trends agreed fairly well with most measurements. The impact of fuel properties (particle size distribution, elemental composition and influence of torrefaction) on emissions performance could be quantified.

**Presenter:** **Timothy GRIFFIN, University of Applied Sciences, Northwestern Switzerland, Institute of Biomass and Resource Efficiency, Windisch, SWITZERLAND**

Presenter's biography:

Bachelor, Master and PhD degrees in chemical engineering. 15 years of experience at ABB and Alstom corporate research centers. Since 2005 professor of thermal energy technology at University of Applied Sciences, Northwestern Switzerland.

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Session reference: 2AO.2.3

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



**Investigation on Syngas Assisted Combustion for Low Emission Operation in Gas Burner**

Short introductive summary:

The EU is tightening the requirements of environmental protection due to climate change and requires to increase the energy efficiency and to reduce environmental impacts. One of the emissions reduction ways is a usage of lean combustion for gas burners in industrial boilers. However, the combustion of lean air-fuel mixture causes the flame instability or abruption, which can lead to formation of thermo-acoustic waves causing vibrations or sudden pressure variations in the combustion system. Also it shortens the lifetime of the combustion system, increase the operational costs and limits the development of low-emission system. These disadvantages force intensive search for innovative solutions to stabilize flame. One of these is co-combustion with syngas obtained by biomass gasification. The hydrogen rich syngas advances the gas mixture ignition and extends the flammability limits, thus ensuring the flame stability and burning the fuel with higher excess of air, the flame temperature decreases leading to the decrease in NO<sub>x</sub> generation. Also co-combustion with syngas expands the spectrum of renewable fuel usage.

Presenter: **Rolandas PAULAUSKAS, Lithuanian Energy Institute, Laboratory of combustion processes, Kaunas, LITHUANIA**

Presenter's biography:

In 2017 I completed my PhD on the investigation of pelletized biomass thermal deformations during pyrolysis at Lithuanian Energy Institute. I am currently working as research associate in Laboratory of Combustion Processes at Lithuanian Energy Institute.

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Session reference: 2AO.2.4

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Understanding the Effects of Nozzle Design and Spray Characteristics for Optimizing Pyrolysis Liquid Biofuel Ignition and Combustion**

Short introductive summary:

This paper examines how nozzle design and spray characteristics influence the combustion and emissions of a pure pyrolysis liquid biofuel (PLB) flame in a 10kW, insulated, swirl burner using an internally mixed air-blast nozzle. PLB (also called bio-oil or pyrolysis oil) is a carbon-neutral fuel made from waste wood, but its properties and water content make efficient combustion challenging. First, atomization trends were examined with distilled water to elucidate the critical parameters and design aspects that most strongly influence atomization and to determine the nozzle's primary atomization mechanism(s). With this information, combustion experiments studied how carbon monoxide (CO), nitric oxide (NO), carbonaceous residue, flame stability and coking were influenced by the nozzle's mixing chamber diameter and outlet number/diameter, angle and total area in order to optimize the design of the nozzle. Ultimately, an optimized nozzle was designed that achieved a self-sustaining PLB flame with good stability, low emissions and low coking. In addition, it successfully operated under "cold-start" conditions and at steady-state conditions did not require a pilot flame

Presenter: **Murray THOMSON, University of Toronto, Mechanical and Industrial Engineering, Toronto, CANADA**

Presenter's biography:

Dr. Murray Thomson is a Professor in the Department of Mechanical & Industrial Engineering at the University of Toronto where he is the Director of the Combustion Research Laboratory.

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Session reference: 2AO.2.5

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Supercritical Methanolysis of Waste Cooking Oil for Biodiesel Production: Experimental Assessment for Evaluating the Effect of Free Fatty Acids Content**

Short introductive summary:

In this study, high acid value waste cooking oil (WCO) has been assessed for biodiesel production using supercritical methanol. A comparative analysis between two different WCOs with dissimilar total acid number (TAN) has been conducted to analyse the effect of free fatty acids (FFA) content on biodiesel production efficiency.

Presenter: **Omar ABOELAZAYEM, London South Bank University, Chemical Engineering, London, UNITED KINGDOM**

Presenter's biography:

Omar Aboelazayem is a PhD Student at the Department of Chemical and Petroleum Engineering, London South Bank University University. His main fields of interest include biofuels production, biorefineries, bioenergy and process simulation & integration

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Session reference: 3AO.3.1

Subtopic: 3.4 Oil-based biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Potential of Nitratireductor Sp. OM-1 to Produce More Short-Chain Esters and Less Excess Sludge during Wastewater Treatment**

Short introductive summary:

Nitratireductor sp. strain OM-1 can convert VFAs into short-chain ester.

Likewise methane fermentation, bio-oil production derived from organic wastes will be proposed using strain OM-1.

Presenter: **Yoshiko OKAMURA, Hiroshima University, AdSM, Higashi-Hiroshima, JAPAN**

Presenter's biography:

Associate Professor of Hiroshima University.

Research interests are marine biotechnology, biomineralization, microbial genome and oil production.

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Subtopic: 3.4 Oil-based biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Reduction of Greenhouse Gas Emissions In Biomass Production by Using Plant Oil Fuel in Tractors**

Short introductive summary:

The use of fossil diesel fuel in tractors considerably contributes to greenhouse gas (GHG) emissions when producing food or biomass feedstock. Regionally produced plant oil fuels may be an alternative for the agricultural sector with a bunch of ecological benefits. It is the purpose of this paper to show the state of the art of pure rapeseed oil operated tractors and their GHG reduction potential. 19 plant oil operated tractors have proved full suitability in everyday use for more than 50,000 operating hours altogether. About 500,000 l of fossil diesel was saved. With rapeseed oil fuel from decentral production GHG reduction of up to 91 % compared to diesel can be achieved. Already today, plant oil fuelled tractors could play an important role within cost-effective decarbonisation strategies of the agricultural sector.

Presenter: **Klaus THUNEKE, Technology and Support Centre in the Centre of Excellence for Renewable Resources, Liquid Biofuels, Biolubricants and Process Materials, Straubing, GERMANY**

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Dr. Klaus Thuneke

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Session reference: 3AO.3.3

Subtopic: 3.4 Oil-based biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Waste Office Paper: a Potential Biorefinery Feedstock for Microbial Lipids for Biodiesel Production**

Short introductive summary:

I am Anu Sadasivan Nair, doing my Ph.D in Sultan Qaboos University, Muscat, Oman. I am working in the area of microbial lipids for biodiesel production from waste paper

Presenter: **Anu SADASIVAN NAIR, Sultan Qaboos university, Biology, Muscat, OMAN**

Presenter's biography:

I am Anu Sadasivan Nair, PhD scholar in Sultan Qaboos university, Al-Khoud, Muscat Oman.

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Session reference: 3AO.3.4

Subtopic: 3.4 Oil-based biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Alternative Jet Fuel Production from Tropical Biomass Resources

Short introductive summary:

Results of a review of biomass feedstocks available in the tropics are presented. Oil expressed from *Millettia pinnata* (common name pongamia) seeds was characterized for relevant fuel properties.

Presenter: **Scott TURN, University of Hawaii, Hawaii Natural Energy Institute, Honolulu, USA**

Presenter's biography:

Scott Turn is a Researcher on the faculty of the Hawaii Natural Energy Institute at the University of Hawaii. Research interests include biomass resource assessment, feedstock processing and characterization, thermochemical conversion, hot gas cleaning, fuel reforming, and biofuel properties.

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Session reference: 3AO.3.5

Subtopic: 3.4 Oil-based biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Optimizing Biomass Utilization - The Consumption of Imported Wood Pellets in New Demand Sectors to Support the Dutch Bio-Based Economy**

Short introductive summary:

The traditional demand for imported wood pellets of large electricity producers in the Netherlands is expected to diminish once existing subsidy schemes will be abolished. The need to replace fossil fuels by biomass in order to meet renewable energy targets, combined with the opportunity to utilize existing supply chains, creates a need to explore the use of solid biomass in other markets. This study will point out potential transition routes to utilize the available solid biomass by analyzing the costs and GHG emissions of white wood pellet and torrefied pellet supply chains, and combining this with an analysis of end user requirements.

Presenter: **Lotte VISSER, Utrecht University, Copernicus Institute - Energy & Resources, Utrecht, THE NETHERLANDS**

Presenter's biography:

Lotte Visser is currently working as a PhD candidate at the Copernicus Institute at Utrecht University. Her research examines supply chain costs of lignocellulosic feedstocks and focuses on logistics costs and supply chain optimization strategies.

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Session reference: 4AV.1.1

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **A Successful Effort to Create Biobased Technology Commercialization Policy in the US State of Minnesota**

Short introductive summary:

The Bioeconomy Coalition of Minnesota is a unique state-based effort to accelerate commercialization of critical biobased technologies. The Coalition was launched in 2012 to address opportunities and deficiencies in the state. Although Minnesota led the USA in developing a first generation corn ethanol industry in the 1980s and 1990s, the state was falling behind in commercializing next generation technologies. The Coalition's first priority was to create state policy incentives to attract commercial-scale projects. After three years of effort the Minnesota Bioincentive program passed the state legislature in 2015. This program offers performance-based incentives for production of advanced biofuels, biobased chemicals, and biomass thermal energy. Having been in place for two years, the program is showing results. Types of projects in the development pipeline include gasification and pyrolysis of forestry residues, corn kernel fiber cellulosic ethanol, renewable natural gas and advanced biofuels from municipal solid waste. The Coalition's approach has demonstrated that a multi-stakeholder coalition can lead to new policy and accelerate commercial deployment of new technology.

Presenter: **Brendan JORDAN, Great Plains Institute, Minneapolis, USA**

Presenter's biography:

Brendan Jordan has 14 years of experience leading biomass technology commercialization initiatives. He is an experienced facilitator, policy advocate, analyst, and project manager.

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Session reference: 4AV.1.2

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

**Competition for Biomass Trade to Meet Global and National Emission Targets for Below 2 °C Trajectories**

Short introductive summary:

The burgeoning trade in bioenergy commodities has led some countries to make broad assumptions about the availability of imports in the future, but there is a lack of evidence to justify these assumptions.

We use a global integrated assessment model (IAM) to explore the potential breadth of bioenergy trade in future scenarios consistent with meeting the well below 2 °C target agreed at COP 21 in Paris. We evaluate the model using a comparison of existing trade from detailed country level assessments, and then compare the assumed availability of imports in national strategies against modelled projections from scenarios in which there is a competitive global biomass market.

We show that a substantial increase in global bioenergy consumption to meet the Paris target would likely be accompanied by an increase in traded bioenergy commodities. Biomass rather than biofuel trade dominates in the long term in our scenarios, despite biomass having a lower energy density. In a case study, we conclude that the UK bioenergy strategy makes overly pessimistic assumptions about the availability of imports in the future that could unnecessarily impede the development of biofuel industries.

Presenter: **Paul DODDS, University College London, UCL Energy Institute, London, UNITED KINGDOM**

Presenter's biography:

Paul Dodds is Senior Lecturer in Energy Systems at UCL in London. His research explores how different technologies might contribute to energy system transitions in the future. His projects span energy storage, hydrogen and bioenergy, and cut across engineering, environment and policy issues.

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Session reference: 4AV.1.3

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Operating Environment for Small-Scale Biomass-Based CHP Production in Finland**

Short introductive summary:

The aim of this paper is to introduce the operating environment for biomass-based CHP units in Finland and conduct a comparative analysis in some other countries.

Presenter: **Antti KARHUNEN, Lappeenranta University of Technology, LUT Energy, Lappeenranta, FINLAND**

Presenter's biography:

Antti Karhunen, M. Sc. (eng.), works as a projects researcher at Lappeenranta University of Technology. His main research subjects are biomass availability and utilization, and analyzes concerning regional and national energy supply.

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Session reference: 4AV.1.4

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **A Village-Based Integrated Biorefinery Model for Rural Areas**

Short introductive summary:

In this work, it is introduced the integrated village-based biorefinery concept ("VBB"), that aims to apply the biomass valorisation concept in biorefineries to small-scale villages (500 - 2000 inhabitants).

This concept is based on four modules: a) biomass production and residue collection, b) anaerobic digestion and biogas upgrade to biomethane, c) microalgae cultivation for advanced wastewater treatment and d) CHP production; creating synergies between process streams.

Presenter: **Bartha SANDOR, Cercetare Silox, BIO C-Romania, Sf. Gheorghe, ROMANIA**

Presenter's biography:

Bartha Sándor is "Senior Research engineer", an expert at the Green Energy Association –(Phonix and BET HR2020 project partner with ESEA- BIO-C), and member of the Green energy Biomass Cluster Sf. Gheorghe Romania, that functioning within Association of the Small and Medium Size Enterprises.

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Session reference: 4AV.1.7

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY



## **European Steel Industry and Emission Reductions by 2020, 2030 and 2050 - The Role of Bioenergy and Carbon Capture and Storage**

Short introductive summary:

The EU climate strategies and targets for 2020, 2030 and 2050 call for decarbonisation of industrial processes, and iron and steel production is amongst the most emission-intensive ones. The 30 operating integrated steel plants (which produce steel via a blast furnace-basic oxygen furnace route) consume nearly 18 % of all European coal and bioenergy together with Carbon Capture and Storage (CCS) are main strategies for decarbonisation of this industry.

This study uses the techno-economic BeWhere model to optimise biomass resources for the integrated steel plants, whilst also considering biomass demand from existing industries. Apart from the biomass aspect, the model also takes into the account the proposed CO<sub>2</sub> pipeline network and CO<sub>2</sub> storage locations. The research enhances the understanding of the role of bioenergy in emission targets set for iron and steel and advise on the best use of biomass in Europe.

Presenter: **Hana MANDOVA, University of Leeds, School of Chemical and Process Engineering, Leeds, UNITED KINGDOM**

Presenter's biography:

Hana Mandová is a PhD researcher at the University of Leeds, part of the Bioenergy Centre for Doctoral Training. Her background is in Mathematics and focus of her PhD work is on optimising the use of biomass for heavy emission and energy-intensive industries, such as iron and steel.

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Session reference: 4AV.1.8

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Replacing Traditional Biomass for Biogas in Rural Communities in Nepal: Lessons Learned from the Chinese Model

Short introductive summary:

This paper investigates the possibility of replacing traditional biomass in rural communities in Nepal with the more sustainable option of biogas produced using household biogas digesters. One example of the success of such a scheme is in China, where biogas digesters have already extensively replaced traditional biomass. Using biogas produced from household biogas digesters has many benefits in comparison to traditional biomass for the purposes of cooking. Household digesters can operate exclusively on livestock manure, agricultural residue, or household waste, resulting in an improvement in sanitation for the communities that use them. Our results show that the Nepalese biogas program can take some inspiration from that of the Chinese, but the organisations in charge must proceed with caution. Household biogas has the potential of being a vital tool in improving the quality of life in rural areas and transitioning the country into using an improved, centralised energy system. This could give Nepal the means to develop its access to clean cooking fuel.

Presenter: **Lydia JOWITT, Oxford University, Oxford, UNITED KINGDOM**

Presenter's biography:

I am in the penultimate year of my undergraduate degree, studying Physics at the University of Oxford. Last summer, I spent two months at the University of Sao Paulo at the Institute of Energy and Environment, researching the feasibility of the Chinese biogas model being implemented in Nepal.

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Session reference: 4AV.1.12

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Technical and Economic Barriers to Produce Biofuels from the Forests: a Case-By-Case Study in Mexico

Short introductive summary:

This research assesses the viability to produce charcoal, woodchip, bark, pellet, sawdust, firewood and mill-site generated wood waste as forest biofuels (FB) in the forest industries of Mexico. The purpose is to identify the barriers to production of FB with direct information from the enterprises, providing with first-hand data to decision makers. This is the first study that collects data from the current situation in the country, estimating the feasibility in real time, within the current technological status, technical knowledge and costs and prices at a glance.

**Presenter:** Daniel COHEN SALGADO, National Autonomous University of Mexico, Institute of Research in Ecosystems and Sustainability- Bioenergy Lab, Morelia, Michoacan, MEXICO

Presenter's biography:

Received a bachelor's degree in Environmental Sciences from UNAM and a MSc in Environmental Policy and Regulation at LSE. I am currently working as a research assistant for a national project in bioenergy, delving into barriers to the use of forest resources as renewable energy in Mexico.

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Session reference: 4AV.1.17

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **The Creation of Bioenergy Villages in Southeastern Europe - Results from The Biovill Project in Macedonia and Slovenia**

Short introductive summary:

The objective of the EU Horizon 2020 funded project BioVill is to support the development of regional bioenergy concepts and the establishment of bioenergy villages in Croatia, Macedonia, Romania, Serbia and Slovenia. This will be achieved by identifying suitable biomass value chains according to local and regional needs and transferring existing experiences gained in Austria, Germany and other European countries to the South-Eastern European partners. Thereby, the market uptake of domestic bioenergy supply chains will be increased and the role of locally produced biomass as a main source of energy supply and added value for the local and regional economy will be strengthened. Core activities of the project focus on supporting the seven selected target villages on their way to become bioenergy villages.

**Presenter: Dominik RUTZ, WIP Renewable Energies, Unit Bioenergy & Bioeconomy, München, GERMANY**

Presenter's biography:

Dominik Rutz is a Senior Project Manager at WIP Renewable Energies ( [www.wip-munich.de](http://www.wip-munich.de)) since 2005. He graduated in Environmental Science (Dipl.-Ing.) and Consumer Science (M.Sc.). His main field of experience includes the technical and non-technical analysis of bioenergy and its supporting policies in developing countries and emerging economies worldwide. He is coordinator of several EU funded projects.

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Session reference: 4AV.1.18

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Development Pathways for the Bioeconomy: Policies, Institutions and Governance**

Short introductory summary:

see Explanatory material

Presenter: **Francis X. JOHNSON, Stockholm Environment Institute, Stockholm, SWEDEN**

Presenter's biography:

Francis X. Johnson has more than twenty years of experience in economic and environmental analysis of renewable energy policies, bioenergy strategies, climate mitigation, and energy efficiency.

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Session reference: 4AV.1.19

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

**Alternative Methods to Kosovo's Cancerous Energy Source - How Can Kosovo Re-Utilize its Lignite and Mitigate Dependency via Green Energy Techniques**

Short introductive summary:

Kosovo's biggest energy asset is also a detrimental cause of harm to the young country- lignite coal. The energy source is the dirtiest, and least efficient, out of all in the coal category. Ever since Kosovo declared independence in 2008, and even prior, Kosovo has experienced serious problems relating to air quality, municipal waste management, and water pollution. Kosovo possesses the fifth largest global reserves of lignite coal, the dirtiest form of coal. The "dirty coal" produces more than 98% of electricity in Kosovo that is fueled by two Soviet built, decades old, power plants, located less than 10 kilometers from the center of Prishtina. This creates a myriad of social and environmental problems for the young country.

Additionally, as a supplemental technique, Kosovo should re-utilize its lignite via "green" energy utilization techniques, such as but not limited to coalbed methane extraction (CBM), coal gasification etc. The past decade has seen lignite-dependent countries such as China, India, and Australia use such techniques successfully and the same energy model should be investigated by the Kosovo government.

Presenter: **Besmir BURANAJ HOXHA, Petro Fluids LLC, none, Houston, USA**

Presenter's biography:

Besmir is a Sr. Research Scientist at the University of Texas at Austin that specializes in Drilling Fluids, Fluids Automation, and Rock Mechanics. He holds a degree in Chemistry/Engineering and a Masters in Operations Research. Additionally, he is a Sr. Technical Adviser at Petro Fluids.

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Session reference: 4AV.1.23

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **To Be or Not to Be a Biobased Commodity**

Short introductive summary:

We argue that the existence of a limited number of defined lignocellulosic biomass commodities will lower transaction costs and will benefit both producers and users of biomass. Machines for commodity production, transport and conversion can be standardized, as well as contracting, and insurance. This will also allow small biomass producers to enter the market even if they are individually too small to engage in supply contracts with large users. We define what a biomass commodity is and why there is a real need to develop these commodities in order for the biobased economy to really take off.

Presenter: **Wolter ELBERSEN, Wageningen Research, Food and Biobased Products Dpt., Wageningen, THE NETHERLANDS**

Presenter's biography:

Wolter Elbersen (1964) is a biomass and bioenergy expert working at Food & Biobased Research of Wageningen University and Research. He has more than 20 years of working experience in bioenergy, biomass production, biomass crops, by-product and waste valorisation and biomass chain development and assessment. In recent years he has contributed or coordinated projects in The Netherlands, EU and abroad (Brazil, Ukraine, Turkey, Suriname, Colombia, and Mozambique). He is a member of the Dutch Commission on Biomass Sustainability and organiser of professional biomass courses for industry and policy makers in The Netherlands.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 4AV.1.25

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Performance Evaluation of Commercial Sanitary Napkin Incinerator

Short introductive summary:

Biomass as a fiber is used in several industries as an input material as in the case of paper, cloth, absorbents, etc. Sanitary napkins and diapers form a significant part and their disposal is an issue of concern. While there are well-established guidelines regarding the bio-medical, MSW and hazardous waste incinerators, there are no well-defined guidelines for sanitary napkin incinerators. This study brings to light the various emission products and their composition from a typical sanitary napkin incinerator available in the Indian market.

Based on the preliminary investigations, it was found that the existing models do not meet the environment standards due to poor quality of combustion. This study focuses on improving the performance of such incinerators by designing in such a way so as to achieve superior performance and to meet the environment norms.

Presenter: **Rohit BOROOAH, Indian Institute of Science, Centre for Sustainable Technologies, Bangalore, INDIA**

Presenter's biography:

I am an engineering student pursuing masters (MSc Engg) from the Centre for Sustainable Technologies at the Indian Institute of Science, Bangalore.

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Session reference: 1AV.2.2

Subtopic: 1.5 Municipal and industrial wastes

Topic: 1. BIOMASS RESOURCES



**Organic Waste to Energy in Latin America and the Caribbean (Lac); State-of-the-Art Literature Review**

Short introductive summary:

Organic waste to energy (OWtE) technologies have been already developed and implemented in Latin America and the Caribbean countries (LAC), but are still a long way to contribute not only to manage and treat the ever-increasing waste volumes in the region but also meet its energy demand and GHG reduction goals. The technical complexity of these technologies, dearth of research, high investment costs and political deficiencies have not allowed an appropriate implementation of these technologies in the region. This paper presents the state-of-the art of OWtE in LAC countries based on archival research method. The outcome shows that OWtE have good potential to improve waste and energy systems in the region, reducing environmental impacts, along with a series of social and economic benefits, such as increasing sustainable energy supply. However, there is still a lack of investment and participation of stakeholders aligned with other challenges, which inhibit the implementation and diffusion of OWtE in the LAC.

Presenter: **Rodolfo SILVA, Universidade de São Paulo, Bioenergy, Piracicaba, BRAZIL**

Presenter's biography:

I am a Mexican civil engineer. Currently, after becoming a Graduate from the Master's Program: "Sustainable Resource Management" at the Technical University of Munich, I am continuing with my academic career at the University of Sao Paulo, at the PhD program in Bioenergy.

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Session reference: 1AV.2.10

Subtopic: 1.5 Municipal and industrial wastes

Topic: 1. BIOMASS RESOURCES

**Accurate Study on the Supercritical Water Gasification of Black Liquor: an Experimental Campaign in Continuous Operation Mode**

Short introductive summary:

The scope of this work was to provide an assessment of weak black liquor conversion into bio-syngas by means of SCWG process. At this aim, a continuous fed system operating at 250 bar and in the temperature range 600-750°C has been used. These temperatures are higher than the usual temperature range of SCWG, which involves additional interest in the following result. The results showed that both hydrogen and methane concentration increases with temperature, reaching 42%vol/vol and 23%vol/vol at 750°C, respectively. As opposite, CO<sub>2</sub> concentration decreased with temperature (from 43% to 34%). The carbon conversion efficiency (CCE) increased from 650°C to 700°C, showing a slight decrease at 750°C. As a consequence, the cold gas efficiency (CGE) reached the maximum value (57%) at 700°C. At these conditions, the lower heating value of the bio-syngas was 13 MJ/Nm<sup>3</sup>, this result raises the potential of this process for energy purposes. These results, obtained by means of a continuous fed SCWG reactor, encourage further investigations in the areas of process integration and optimization.

Presenter: **Mauro PRESTIPINO, University of Messina, Engineering Dpt., Messina, ITALY**

Presenter's biography:

Researcher in the field of residual biomass gasification. Part of the research activity is focused on the kinetic study of biomass decomposition in H<sub>2</sub>O atmosphere. PhD degree at University of Messina, Department of Engineering.

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Session reference: 1AV.2.13

Subtopic: 1.5 Municipal and industrial wastes

Topic: 1. BIOMASS RESOURCES

## **Toxicity and Properties of Biochar Mineral Complexes (BMCs) Derived from Pyrolysis and HTC Evaluated by Germination Trials**

Short introductive summary:

Chars and BMCs were produced from two feedstocks with different production technologies / conditions and three minerals added in various ratios. The objective was to investigate whether mineral addition to chars affects plant germination and growth (watercress as model organism) and whether the phytotoxicity of salts can be reduced by the minerals in BMCs.

Presenter: **Josephine GETZ, Dublin Institute of Technology, Environmental Sustainability & Health Institute, Dublin, IRELAND**

Presenter's biography:

Master and Bachelor at the Humboldt Universität zu Berlin then working shortly at the University of Edinburgh for the UK Biochar Research Center (UKBRC). Now in Dublin for PhD at Dublin Institute of Technology (DIT).

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Session reference: 1AV.2.15

Subtopic: 1.5 Municipal and industrial wastes

Topic: 1. BIOMASS RESOURCES

## Potential of Tropical Fruit Waste in Bioenergy Processes and Bioproducts Design

Short introductive summary:

Nowadays nearly 12 million tons of wastes are produced in Colombia [1] in which the 53% are organic residues such as fruit peels [2]. These residues represent a great opportunity of energy conversion and value-added products in companies that export dry fruit and pulp from bananas, dragon fruit, golden berry, mango and pineapple. First of all, a proximate compositional analysis was elaborated in order to determine specific quantities of total solids, ash, extractives, protein, lignin, cellulose, hemicellulose and pectin. The production of biogas, the extraction of pectin and the use of mango kernel oil to formulate cosmetic products are some of the possibilities studied to benefit from waste originated in a dehydration processing plant. With this study, we aim to find not only a solution to the problem that represents waste in our country but also to take advantage of those in order to create new incomes and energy solutions, which are important for Colombia's growth and development.

Presenter: **Daniel David DURÁN ARANGUREN, Universidad de los Andes, Chemical Engineering, Bogotá, COLOMBIA**

Presenter's biography:

Chemical Engineer - Universidad de América, Bogotá, Colombia - 2014

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Session reference: 1AV.2.18

Subtopic: 1.5 Municipal and industrial wastes

Topic: 1. BIOMASS RESOURCES

## Septic Tank Sludges as Part of The Optimized Sewage Treatment Process

Short introductive summary:

Rural areas without sewage coverage rely strongly on on-site sanitation systems such as septic tanks for disposal of sewage. Separation of solid matter from the liquid part will occur and sludge is formed on the bottom of the tank. Septic tank sludges can be feeded into municipal wastewater treatment process in their current form or after pretreatment. Suitable pretreatment techniques can be physical, chemical or biological, for instance sedimentation, centrifugation, ultrasound treatment and chemical oxidation. Anaerobic digestion is an effective method for sludge treatment and recycling. Optimally septic tank sludges can be mixed with other sludges (such as pre-clarified sludge) at wastewater treatment plant before sending them for anaerobic digestion process for biogas and methane production. Phase separation of material flows will maximize utilization of process technologies, increase cost-effectiveness and have positive impact on quantity and quality of final products.

Presenter: **Heikki SÄRKKÄ, South-Eastern Finland University of Applied Sciences, Forest, the environment and energy, Mikkeli, FINLAND**

Presenter's biography:

Dr. Sc. (Eng.) Heikki Särkkä is working as a project manager at South-Eastern Finland University of Applied Sciences. His research interests are mainly in biogas production from secondary raw materials and developing novel wastewater treatment technologies.

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Session reference: 1AV.2.24

Subtopic: 1.5 Municipal and industrial wastes

Topic: 1. BIOMASS RESOURCES

## Revealing Bioenergy Potentials: Mapping Marginal Lands in Europe - The Seemla Gis-Tool

Short introductive summary:

Marginal land (MagL) use for biomass production has received a lot of attention in the past decades. This alternative land use is free from conflicts with food crops, however it presents multiple challenges. The major issue to be resolved is the definition of marginal lands, which varies between disciplines and is often determined based on management goals. Moreover, concerns over the impacts of MagL use on environment, ecosystem services and sustainability have to be addressed.

In response to these issues, the SEEMLA approach proposes an algorithm and tools to support MagLs identification and mapping, as well as the assessment of their potential for biomass production. The SEEMLA algorithm assesses land marginality using the Muencheberg Soil Quality Rating (M-SQR) developed by Mueller et al. (2007). The algorithm also incorporates criteria to eliminate MagLs that may not be exploitable for bioenergy due to ecological and environmental issues or regulatory and legal restrictions and constraints posed by national or EU policies applied. Finally, MagL suitable for bioenergy production is categorized based on climatic zone and crop suitability.

Presenter: **Spyridon GALATSIDAS, Democritus University of Thrace, Department of Forestry and Management of the Environment and Natural Resources, Orestiada, GREECE**

Presenter's biography:

Associate Professor, Forest management – management of non-timber functions of forest. Department of Forestry and Management of the Environment and Natural Resources, Democritus University of Thrace (2010 till now).

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Session reference: 1AO.4.1

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

**ELBA: a National Reference Tool for Agricultural Biomass Resource Assessment**

Short introductive summary:

French National strategy for biomass mobilization and Bio economy placed agriculture biomass among main resources to reach renewable energy and GHG emissions objectives. Need for a better knowledge in local resource assessment was noticed as a break down for projects development. Five main French farming R&D institutes joined forces to build a reference tool based on previous works (Labalette et al. 2012) to assess and map agricultural biomass resources in France for National policy and stakeholders. An innovative methodological approach has been applied for biomass crops (residues, energy crops) and livestock biomass (slurry, manure) quantification. The purpose was to value different national statistical database (agricultural census, specific survey, ...) with experimental reference and expertise of the partners.

Biomass amount can be converted into different useful physical units (dry matter, organic matter, bio-methane potential) and mapped on the whole metropolis at NUTS 2, NUTS 3 or NUTS 4 detail. Further work is needed to improve some technical parameters but this tool represents a big step in establishment of national platform on biomass resources.

Presenter: **Sylvain MARSAC, ARVALIS - Institut du Végétal, R&D - Agronomy Economy Environment Dpt., Baziège, FRANCE**

Presenter's biography:

Sylvain MARSAC

Engineer for 14 years

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Topics :Economics: profitability, competitiveness of farmers; Adaptation strategies with biomass use : field trials, integrated assessment, resource assessment

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Session reference: 1AO.4.2

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

**Mobilisation of Unloved Woods for Bioenergy at the Heart of Quebec Communities**

Short introductive summary:

Surplus forest growth, i.e. roundwood from whole trees that could be harvested over and above current harvesting rates while still remaining within sustainable harvest rates, is a particularly abundant but yet largely untapped and seemingly controversial, source of forest biomass for the production of bioenergy. A special case of this category is trees of marginal fibre quality, such as defective, decaying or dying trees, or trees from unwanted species, together i.e. unloved woods. In Canada, a substantial volume of unloved woods goes unutilized despite being part of the forest annual allowable cut. Factors explaining the abundance of unloved woods include a combination of: forest product market pricing; operational difficulties; wood properties and tree/stand characteristics, and most importantly, the regional structure of the wood processing industrial network. These unloved woods represent an attractive source of biomass for bioenergy, and adding bioenergy players in current industrial networks would have an important mobilisation effect on the whole forest value chain and communities.

Presenter: **Evelyne THIFFAULT, Laval University, Wood and Forest Science, Quebec, CANADA**

Presenter's biography:

Evelyne Thiffault is an assistant professor in forest soils and forest biomass at the department of wood and forest sciences of Laval University (Canada) and member of the Research Centre on Renewable Materials.

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Session reference: 1AO.4.3

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES



## **Spatially Explicit Assessment of the Theoretical, Technical, Economic, Environmental and Sustainable Potential of Biomass for the Biobased Economy**

Short introductive summary:

The objective of this study is to develop a spatially explicit approach to assess current and future theoretical, technical, economic, environmental and sustainable biomass potentials. This approach is demonstrated for the potential of sugar cane ethanol production in Brazil. Although there is a very high theoretical (80 EJ/y) and technical potential (17-21 EJ/y) of sugarcane ethanol in Brazil in 2030, the potential significantly decreases (to 0.4-1.6 EJ/y) when economic and environmental constraints are applied. This approach could strongly support decision making on sustainable deployment of biomass for the biobased economy.

Presenter: **Floor VAN DER HILST, Utrecht University, Energy & Resources, Copernicus Institute, Utrecht, THE NETHERLANDS**

Presenter's biography:

Floor works as Assistant Professor for the Copernicus Institute at Utrecht University. Her work focuses on land-use change related to biomass production and its impacts. She combines methodology and model development with fieldwork experience.

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Session reference: 1AO.4.4

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

**Assessing the Sensitivity of National Energy Infrastructure Decisions to Imported Biomass Feedstocks: a Uk Case Study Using the Biomass Value Chain Model**

Short introductive summary:

The global trade in wood pellets has massively expanded over the past couple of years. Particularly, activity has been seen in the United States where, in 2015, 98% pellets were exported to the European market. The demand for pellets has been driven largely by EU renewable energy targets. Since 2010, wood pellet imports to the United Kingdom (UK) have been increasing, with a near exponential increase in supply from North America. With such large global trade occurring in wood pellets, it is important to understand the impacts on our ability to meet GHG reduction targets and impacts on energy systems infrastructure. Here we use the UK as a case study to highlight these impacts: A total of 14 experimental scenarios were explored using the Biomass Value Chain Model (BVCM), a spatial-temporal mixed integer linear programming model. Three key findings were made: (i) Without Bioenergy with Carbon Capture and Storage (BECCS) the model is unable to solve. (ii) The amount of SRF pellets imported changed when their associated emissions changed. (iii) Whilst changes are observed in the type of feedstock imported, the effects on the whole system in terms of GHG mitigation and costs is minimal.

Presenter: **Zoe HARRIS, Imperial College London, Centre for Environmental Policy, London, UNITED KINGDOM**

Presenter's biography:

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Session reference: 1AO.4.5

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

**Combustion Behaviour and Slagging Tendencies of Kaolin Additivated Agricultural Pellets and of Wood-Straw Pellet Blendings in Small Scale Boilers**

Short introductive summary:

The ERA-NET Project “BioFlex!” aims at utilisation of agricultural fuels for failure free and low emission combustion in domestic biomass boilers. Within the project, the effect of kaolin additivation of four agricultural biomass fuels (i.e. wheat straw, short rotation poplar, sunflower husk and grass) as well as of fuel blendings of wheat straw with woody biomass was assessed regarding improvements in combustion behaviour in small scale boilers. Due to additivation with kaolin and due to fuel blending, PM and CO emissions could be reduced by 53.3–76.8% and by 68.6–94.9% compared to pure fuels, respectively. In addition, slagging tendencies of the agricultural fuels was reduced, as well. Thus, additivation with kaolin or blending of fuels might be interesting options for the utilisation of “difficult” agricultural biomass. However, regarding the pelletisation process itself, a distinct increase in wearing off of the dies and the rollers of the pellet mill was observed. This also has to be considered during production.

**Presenter: Daniel KUPTZ, Technology and Support Centre of Renewable Raw Materials, Solid Biofuels Dpt., Straubing, GERMANY**

Presenter's biography:

Daniel Kuptz studied Forestry Science at Technical University of Munich (TUM) and did his PhD at the Chair of Ecophysiology of plants (TUM). He works as a researcher and as assistant manager in the department for Solid Biofuels at TFZ.

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Session reference: 2AO.5.1

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Fuel Flexible and Low-Emission Biomass Combustion by Combination of Fuel Additivation and Combustion Related Primary Measures**

Short introductive summary:

The demand for wood fuels for biomass heating and CHP plants is steadily increasing, thus the prices also rise accordingly, which results for more and more plant owners in economic problems. The utilisation of non-wood biomass fuels, e.g. Miscanthus, grass and agriculture residues such as straw, corn cobs or sunflower husks would be a possible alternative, but due to ash-related problems (slagging, deposit formation, corrosion and enhanced particulate matter emissions) these fuels cannot be used in conventional biomass heating systems designed for wood fuels so far. Currently available biomass heating systems for the utilisation of non-wood biomass fuels need a high system complexity and cost intensive secondary measures have to be applied to keep strict emission limits.

Presenter: **Christoph MANDL, Bios Bioenergiesysteme, Graz, AUSTRIA**

Presenter's biography:

Christoph Mandl studied Process Engineering at the Graz University of Technology in Graz, did his PhD at the Graz University of Technology and since January 2010 works as a senior project engineer at BIOS BIOENERGIESYSTEME GmbH in the research department.

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Session reference: 2AO.5.2

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Blending Biomass: Dilution or Chemical Reaction in Combustion Process**

Short introductive summary:

The present study proposes an innovative modelling tool for biomass blending based on theoretical predictions assuming thermodynamic equilibrium, ie the ash of each biomass reacts in-between completely. To this purpose, phase diagrams and the software Factsage [4] were used with a suitable database [5]. Experimental validation of the calculations was performed by laboratory-scale annealing of ash or pellet at 1000°C followed or not by quench in air. The samples were characterized by SEM-EDX and XRD in order to identify the presence of liquid and crystalline phases. Pilot-scale validation was then performed with combustion tests of the optimal biomass blends predicted in a 50kW moving grid boiler.

Presenter: **Gilles RATEL, CEA-TECH, LITEN/DTBH Dpt., Grenoble, FRANCE**

Presenter's biography:

Gilles Ratel is a researcher in energy engineering at the LITEN institute (the Laboratory for Innovation in New Energy Technologies and Nanomaterials) of CEA. Its works focus on biomass preparation and on biomass thermal transformation to Syngas.

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Session reference: 2AO.5.3

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Hysteresis in Wood Log Combustion Demonstrated through Transient CFD Simulations and Experiments**

Short introductive summary:

In the present work, it has been demonstrated, both numerically and experimentally, that the flow conditions in a wood stove can significantly fluctuate and that a small disturbance can change the velocity field rapidly and completely. Steady state simulations performed for a selected wood stove geometry showed that there exist two solutions for the case studied. It was possible to switch from solution one to solution two by patching a disturbance into the first solution and using this one as the initial field. The same phenomenon was demonstrated through transient simulations.

Presenter: **Mette BUGGE, SINTEF Energy Research, Thermal Energy, Trondheim, NORWAY**

Presenter's biography:

Mette Bugge, MSc, Mech Engineering, The Norwegian University of Science and Technology. Since 1991 research scientist at SINTEF Energy Research. Main research topics; Combustion of gas and solid fuels, NO<sub>x</sub> formation and reduction, CFD.

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Session reference: 2AO.5.4

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Optimization of Wood Combustion in Low-Power Firing Systems by Sensor-Based Operation: High Temperature CO/HC Sensor for Long-Term In-Situ Operation**

Short introductive summary:

An advanced combustion air mass stream controll system for extensive reduction of wood combustion low-power appliances is reported. In addition a very new procedure for sensitivity check and regeneration of a sensor element for monitoring of the uncombusted gaseous residuals in the flue gas tube is discussed for the first time. This enables long-term application of those sensor elements and will enable a technology jump for development of novel wood combustion appliances emitting much lower amounts of toxic gas components and PM in near future.

Presenter: **Heinz KOHLER, Karlsruhe University of Applied Sciences, Inst. for Sensor and Information systems, Karlsruhe, GERMANY**

Presenter's biography:

Studies of physics at Karlsruhe Institute of Technology (KIT), Max Planck doctoral fellow ship, head of a chemical sensor group at Endress+Hauser Conducta GmbH, now professor for Physics and Chemical Sensors and head of the sensor research group on Inst. for Sensor and Information Systems.

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Session reference: **2AO.5.5**

Subtopic: **2.2 Biomass and bioliquids combustion for small and medium scale applications**

Topic: **2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY**

## **Comparative Technoeconomic and Environmental Assessment of Lignocellulosic Marine Biofuel Production in Scandinavia**

Short introductive summary:

In 2020, the open-water sulfur cap for marine fuels drops from 3.5% to 0.5%. Along with an impending 2018 greenhouse gas reduction plan, it represents a challenge for maritime industries and an opportunity for the alternative fuels that have lower environmental impacts but are not yet economically competitive.

This work analyzed marine biofuels systems to estimate their technical, economic, and environmental performance in 2020, including the conversion of pine, spruce, barley, and wheat residues via hydrothermal liquefaction, fast pyrolysis, and gasification with Fischer-Tropsch synthesis. The hypothetical biorefineries were sited in Denmark, Finland, Norway, and Sweden to include the impact of regional differences on feedstock availability, fuel demand, capital and operating costs, and life cycle emissions of greenhouse gases, SO<sub>2</sub>, and NO<sub>x</sub>, as well as non-renewable energy use.

The modelled biofuels were estimated to satisfy marine fuel demand and comply with environmental regulation. However, their economic competitiveness will depend the cost of low sulfur fossil fuels. Extensive sensitivity analysis highlight work needed to reduce technological and economic uncertainties.

Presenter: **Samantha TANZER, TU Delft, Faculty of Technology, Policy, and Management, Delft, THE NETHERLANDS**

Presenter's biography:

Samantha Eleanor Tanzer is a PhD researcher for Negative Emissions in the Industrial Sector at TU Delft. She obtained a joint master's degree in Industrial Ecology at TU Delft and Leiden University and her bachelor's degree in Economics at Swarthmore College in the USA.

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Session reference: 3AO.6.1

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## A Two Step Process for the Hydrothermal Reforming of Sucrose

Short introductive summary:

This work presents a two-step process for the complete hydrothermal reforming of sucrose. Sucrose is first hydro-treated under mild conditions using H<sub>2</sub> to produce a stable mixture of polyols (sorbitol and mannitol) with high selectivity. The reforming of the polyol mixture provides greater gasification efficiencies with no coke formation, in comparison to the direct reforming of sucrose, which has low gasification efficiencies due to severe coking. This process is considered to be advantageous for aqueous biomass feeds (sugars and carbohydrates) that have a coking tendency.

Presenter: **Varsha PAIDA, University of Twente, Faculty of Science and Technology, Enschede, THE NETHERLANDS**

Presenter's biography:

Varsha Reddy Paidá is currently a researcher in the group of Sustainable Process Technology (SPT) at the University of Twente. She has almost completed 3 years of her PhD. Her research is on the hydrothermal conversion of biomass into gaseous fuels.

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Session reference: 3AO.6.2

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Retro-Techno-Economic-Environmental Analysis (RTEEA) Applied to a First and Second Generation Ethanol Production**

Short introductive summary:

Innovative processes have a greater chance of being successfully implemented industrially if economic and environmental analysis are performed early in process development. Process Systems Engineering tools (PSE) allied with technical-economic analysis (TEA) and life-cycle assessment (LCA) can be used to identify possible bottlenecks and provide targets for research and development teams in a methodology called Retro-Techno-Economic-Environmental Analysis (RTEEA). RTEEA aims at finding threshold values for key process variables that bound economically and environmentally feasible region. RTEEA was applied to a first and second generation ethanol process. Sugarcane bagasse diverted from the combined heat and power process is pretreated and the xylose rich liquid phase is fermented to produce ethanol. The solid phase is burned to produce heat. Greenhouse gases emissions and the process net present value were chosen for performance metrics. The methodology was able to identify the main process variables that influence the process economic and environmental performance, derive their threshold values, and unfeasible regions, where economic feasibility could not be achieved.

Presenter: **Marcelo RIBEIRO, Federal University of São Carlos, Chemical Engineering, São Carlos, BRAZIL**

Presenter's biography:

Associate Professor of the Chemical Engineering Department at Federal University of São Carlos (UFSCar), where he has been since 2013. Received a B.S. in 2002 and his Ph.D. in 2007, both in Chemical Engineering from UFSCa.

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Session reference: 3AO.6.3

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## A Novel Business-Inspired Decision Making Methodology for Selection of Chemicals to be Produced From Biomass

Short introductive summary:

To decide which chemicals should be produced from biomass previous works have proposed decision making methodologies based on optimization of technology superstructures. In all cases, the set of possible products is assumed given and usually correspond to a subset of the chemicals proposed in the US DOE [3] or UE Brew [5] reports. These lists are based on the need of substituting chemicals that are currently produced from oil for their biomass based analogues. This substitution argument may not apply to countries that are rich in biomass but do not currently produce the chemicals that are intended to be substituted. The aim of this work is to propose a methodology to select a set of products to be produced from biomass taking into account the industrial structure and expertise of the region in which the biorefinery will be placed. A two-step systematic process is proposed: first, an expert based all inclusive list of candidates is prepared and narrowed down by considering particular features of the country; then candidates in the short list are ranked using Porter's analysis (a rigorous business management tool). The methodology is demonstrated taking Uruguay as a case s

Presenter: **Soledad GUTIÉRREZ, Universidad de la República, Montevideo, URUGUAY**

Presenter's biography:

Associate Professor at University of the Republic, Uruguay. Head of the Research Chemical Process and System Engineering group (gISQP, <https://www.fing.edu.uy/iiq/grupos/gisqp>).

Currently working in biorefinery and energy savings in biomass deconstruction.

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Session reference: 3AO.6.4

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Life Cycle Assessment of New Biorefinery Concepts Producing Platform and Specialty Chemicals Based on Woody Biomass**

Short introductive summary:

In the structural change towards a sustainable bio-based economy, the effective use of biogenic raw materials and residues in integrated, multi-output biorefinery concepts becomes increasingly important. The demonstration project KomBiChemPro aims at demonstrating new biorefinery concepts completely converting all woody biomass components in multiple platform and specialty chemicals such as xylonic-, malic-, and dicarboxylic acid, chemical pulp and bio-THF using combined chemical and biotechnological processes. In addition, the objectives of the project are to ensure a robust, efficient and integrated process management in order to produce economically feasible products and to guarantee high GHG saving against the petrochemical products to be replaced. Based on detailed mass and energy balances calculated with AspenPlus, a life cycle assessment (LCA) has been conducted for these new, integrated biorefinery concepts and processes. Two of the scoping questions of the LCA are to calculate the environmental benefits of the biorefinery concepts compared with their conventional fossil-based production systems and to identify the concept with the highest GHG saving.

Presenter: **Kathleen MEISEL, DBFZ-German Biomass Research Centre, Bioenergy Systems Dpt., Leipzig, GERMANY**

Presenter's biography:

Kathleen Meisel holds a Diploma in Geography and obtained a doctorate in the field of environmental assessments. As a research scientist at DBFZ she primarily conducts life cycle assessments of biofuel-, bioenergy- and biomaterial production systems.

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Session reference: 3AO.6.5

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **The New IEA Bioenergy Technology Roadmap: a Step Towards a Sustainable Bioeconomy?**

Short introductive summary:

Recently, the IEA has integrated the previous roadmaps for biofuels (2011) and bioenergy (2012) into a single and updated version, using the most recent global scenarios to clarify bioenergy's role in reaching the 2 °C target of the Paris Climate Treaty.

For the first time, the new IEA roadmap explicitly reflects on the role of the bioeconomy, and addresses core issues of biomass sustainability, and respective governance.

The presentation will provide key findings of the IEA roadmap, and discuss its role with regard to IEA's Global Energy Outlook 2017 and the upcoming IPCC Special Report on reaching a 1.5 °C climate target.

In addition, the relevance of the new roadmap for the development of a sustainable bioeconomy will be discussed, especially addressing governance issues.

**Presenter: Uwe R. FRITSCHÉ, IINAS, Scientific Director, Darmstadt, GERMANY**

Presenter's biography:

He studied applied physics at TU Darmstadt, 1984-2011 head of Energy & Climate Division of Öko-Institut in Darmstadt. Since 2012, he is Scientific Director of IINAS (International Institute for Sustainability Analysis and Strategy - [www.iinas.org](http://www.iinas.org)).

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Session reference: 4AV.3.1

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Charcoal Production in Kenya. Ensuring Sustainability in Hotspots Areas

Short introductive summary:

Biomass is the main source of energy for households in Kenya, and a major energy source for the country as a whole. Charcoal provides 82% of household energy in urban areas, and 34% in rural areas. The charcoal sector employs nearly 900,000 people in production and trade, and has been estimated to contribute US\$1.6 billion per year to Kenya's economy. Since 2009, Kenya has adopted policies and regulatory frameworks to formalize the charcoal sector particularly in hotspots where more harvesting for charcoal production is taking place (drier areas in Kenya). This paper examines the progress in adopting and implementing these policies, opportunities and key challenges in realizing a sustainable biomass sector through combined data from the supply chains with information from stakeholders. One workshop and field visits to two hotspot regions in Kenya provided the information.

Presenter: **Hannah WANJIRU, Stockholm Environment Institute, Nairobi, KENYA**

Presenter's biography:

I possess 8 years' experience working on research and implementation of projects, policy development, resources and community mobilization. I have interest in natural resources & Renewable Energy, with particular interest in assessing drivers influencing adoption of energy efficient technologies.

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Session reference: 4AV.3.4

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Assessing the Sustainability of Miscanthus Biomass Production on Marginal Land**

Short introductive summary:

In this study, the environmental, economic and social performance of the miscanthus cultivation on marginal land is assessed based on field trials and the involvement of various stakeholders. A special focus is on the interlinkages between the three sustainability dimensions.

Presenter: **Moritz WAGNER, University of Hohenheim, Institute of Crop Science (340b), Stuttgart, GERMANY**

Presenter's biography:

PostDoc at the Institute of Crop Science, Department of Biobased Products and Energy Crops at the University of Hohenheim

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Session reference: 4AV.3.6

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Developing a Socio-Economic Framework for the Assessment of Rural Biorefinery Projects

Short introductive summary:

The purpose of this work is to identify the factors of the territorial embeddedness of rural biorefineries. This implies not only determining the socio-economic impacts of a biorefinery on its home territory, but also identifying the characteristics of the territory that will influence the structuring and development of this kind of agro-industry. A comparative analysis of two rural biorefineries evolving within two different territories in France has been undertaken. This presentation targets to underline through the literature and these case-studies what spatial and social factors influence the “building” of a biorefinery and what economic and social impacts could be expected.

Presenter: **Miravo RAKOTOVAO, Troyes, FRANCE**

Presenter's biography:

I am a PhD Student at the University of technology of Troyes (France). My research concerns the socio-economic aspects of biorefineries, especially those located in rural areas.

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Session reference: 4AV.3.8

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY



## **An Appraisal Comparison of Locomotives Powered by Biodiesel and Electricity: an Indian Railways Case Study**

Short introductive summary:

Rail is considered as “The Lifeline of India”, but with the continuing dependence on oil and increasing GHGs and pollutants, there is a need to reduce both. There are different, albeit, difficult options to reduce carbon emissions for rail, for example, increasing the efficiency of vehicles and reducing the carbon intensity of fuels. Renewable energy and alternate energy carriers such as electricity or biofuels are possible options to reduce carbon intensity of fuel. However, there are advantages and disadvantages to each of the options, which should be evaluated to compare not only the environmental impact but also economic costs.

Presenter: **Charlotte STEAD, University of Leeds, Pontefract, UNITED KINGDOM**

Presenter's biography:

Charlotte Stead is a PhD researcher in the Bioenergy Centre for Doctoral Training at the University of Leeds. Having a background in economics her thesis is appraising the use of biodiesel for Indian Railways from an environmental and economic perspective.

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Session reference: 4AV.3.10

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Sustainability Assessment and Monitoring of Biomass Production: the Case of Planted Forests in Brazil**

Short introductory summary:

In this study, we explore the motivations behind farmers' decisions to plant trees with commercial purpose and the sustainability and socio-economic aspects of their use for energy in Brazil.

Presenter: **Manuela CZINAR, Imperial College London, Centre for Environmental Policy, London, UNITED KINGDOM**

Presenter's biography:

PhD researcher on biomass sustainability focusing on planted forests in Brazil. 10 years industry experience in biofuels.

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Session reference: 4AV.3.12

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## A Comparative Assessment of Current and Future Fuels for the Transport Sector

Short introductive summary:

To facilitate the transition to a sustainable and less fossil dependent transport sector in the short to medium term, the current fuel mix needs to be enriched with renewable fuel alternatives. This work illustrates that a wide range of biomass based fuel alternatives is available and could be considered relevant for this purpose. The focus is on drop-in options. The advantage of drop-in fuels is that they can be blended with existing (fossil) alternatives without requiring extensive vehicle engine and fuel infrastructure modifications. Most of these fuels however are under development and therefore a systematic review based on fuel performance, environmental and economic criteria, is needed to be able to assess their future potential. Qualitative and quantitative indicators are used and integrated into a multi-criteria assessment process in this study. Comparison to existing fuels further highlights gains but also possible losses with the objective of supporting decision making both for industry and policy makers.

Presenter: **Sofia POULIKIDOU, Chalmers University of Technology, Gothenburg, SWEDEN**

Presenter's biography:

Sofia Poulikidou is a researcher in the area of environmental systems analysis with a focus on the transport sector, alternative fuels, and drive-trains. She is an environmental engineer and holds a Ph.D. in Planning and Decision Analysis with specialization in Environmental Strategic Analysis.

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Session reference: 4AV.3.14

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Social Life Cycle Assessment (s-LCA) for Advanced Biofuel from Waste Wood Integrated in the Steel Industry

Short introductive summary:

Within the EU project TORERO (TORefying wood with Ethanol as a Renewable Output: large-scale demonstration), a cost-, resource-, and energy-efficient technology concept for producing bioethanol from a wood waste feedstock, fully integrated in a large-scale, industrially functional steel mill will be demonstrated. Wood waste is converted to bio-coal by torrefaction, bio-coal replaces fossil powdered coal in a steel mill blast furnace. Carbon monoxide in blast furnace exhaust fumes is microbially fermented to bioethanol and material and energy loops of the process are closed to a very large degree. Every steel mill that implements this concept will be able to produce at least 80 million litres of bioethanol per year. This project creates a value chain for wood waste, which currently has no attractive applications. TORERO is add-on technology that can be used to upgrade existing facilities of the steel sector, an industry that is actively scouting for technological solutions to make its production processes more sustainable. To assess this sustainability and in addition to a Life Cycle Assessment (LCA) that will be used for the environmental assessment, a social Life Cycle

Presenter: **Gerfried JUNGMEIER, Joanneum Research Centre, Research Centre for Climate, Energy and Environment, Graz, AUSTRIA**

Presenter's biography:

Highlights of professional experiences:

- life cycle assessment of bioenergy for transport, electricity, heat and biorefineries
- greenhouse gas assessment of products and services
- sustainability assessment and future scenarios for transportation fuels of the future iV biofuels, e-mobility and hydrogen
- Austrian Representative in activities of the International Energy Agency (IEA) on "Bioenergy", "Hybrid and Electric Vehicle (HEV)" and "Alternative Motor Fuels (AMF)"

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Session reference: 4AV.3.16

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **A New Approach to Evaluate iLUC and Indirect Effects Using Statistics on Crop Cultivation, Land Use, Trade and Deforestation - Examples from the US**

Short introductive summary:

This paper presents an integrated framework describing interlinkages between biomass demand, land use, crop production and conversion as well as trade and area expansion. It derives hypotheses biofuel policies, models and other contributions and lists indicators to check the probability that changes in the complex land-food-feed-trade continuum occurred. The approach is used to evaluate impacts of US biofuel policies in 2005. Results confirm domestic corn production and corn yield increase accelerated considerably. Corn area expanded but agricultural area in the USA declined. There have been no apparent additional imports from Brazil to compensate for corn application in ethanol production. Further analysis of US animal feed demand, imports and crop prices is ongoing.

Presenter: **Hans LANGEVELD, Biomass Research, Bennekom, THE NETHERLANDS**

Presenter's biography:

I am passionate about getting more value from residues, sustainable land use and biomass production. Nearly 30 years experience in analysing cropping systems, land use and renewable energy. Background in agronomy. Founder of Biomass Research, consultant, author and chair.

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Session reference: 4AV.3.18

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Assessment of Economic Viability and Yield Stability of Combined Food and Energy Production System (CFE) in Denmark**

Short introductive summary:

SustainFARM was selected for funding in a competitive process among 67 proposals, following an evaluation by an international panel of reviewers: <http://facceturplus.org/joint-calls/first-call/>. SustainFARM is a transnational research project funded by ERA-NET Cofund FACCE SURPLUS (Sustainable and Resilient agriculture for food and non-food systems), in collaboration between the European Commission and a partnership of 15 countries in the frame of the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI). FACCE SURPLUS is committed to improve collaboration across the European research landscape in diverse, integrated food and non-food biomass production and transformation systems, including bio refining.

Presenter: **Ying XU, Copenhagen, DENMARK**

Presenter's biography:

Ying Xu finished her master of Agriculture in the University of Copenhagen and bachelor of Seed Science and Engineering in China Agricultural University, now she is working as a research assistant in the University of Copenhagen doing the modeling of agro-economic analyze.

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Session reference: 4AV.3.20

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

**Gender Inclusion in Bioenergy. A Case Study in Jaen, Spain**

Short introductive summary:

Women have an important role within the energy sector both as employees and at household level. The literature has focused more on these roles in developing countries and very little research exists on energy and gender within developed countries, and particularly on bioenergy and gender. A lack of gender-disaggregated data and the presence of data that is often double-counted for agriculture and forestry also makes any quantitative analysis difficult. A case study in Jaen, Andalusia, Spain, was used to identify ways in which the participation of women in particular within the bioeconomy and energy sector can be assessed. Using the supply chain of olive-oil residues, it set out to first identify suitable indicators and themes that could be used to measure and demonstrate the differences between men and women within the bioenergy sector. The indicators chosen were employment, unemployment, use of resources, income, land-ownership, accidents at work, perceptions, empowerment and inclusiveness and education. Overall, 21 semi-structured interviews were conducted and a survey was applied to 18 producers on themes from income to land-ownership.

Presenter: **Rocio DIAZ-CHAVEZ, Stockholm Environment Institute - Africa Centre c/o World Agroforestry Centre (ICRAF), Centre for Environmental Policy, Nairobi, KENYA**

Presenter's biography:

Dr Diaz-Chavez is a Visiting Senior Research Fellow at the Centre for Environmental Policy of Imperial College London and Deputy Director of the Stockholm Environment Institute at the African Centre. Her main area of expertise is on sustainability assessment applied in bioeconomy and bioenergy.

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Session reference: 4AV.3.21

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Co-Production of Bio-Insulating Oil and Value-Added Glycerol Derivatives from Soybean Oil**

Short introductive summary:

Fatty acid methyl esters (FAMES) as bio-insulating oil and value-added glycerol derivatives (glycerol carbonate and glycerol dicarbonate) were co-synthesized from soybean oil via transesterification using Novozyme 435.

Presenter: **Eun Yeol LEE, Kyung Hee University, Department of Chemical Engineering,, Gyeonggi-do, REPUBLIC OF KOREA**

Presenter's biography:

Dr. Eun Yeol LEE is a professor of Chemical Engineering Department at Kyung Hee University. His research interests are Protein/Metabolic Engineering and Biorefinery for the production of Biofuels, Biochemicals and Biopolymers from lignocellulosic biomass, macro-/microalgae and methane gas.

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Session reference: 3AV.4.7

Subtopic: 3.4 Oil-based biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## **Evaluation of the Optimal Reaction Conditions for the Methanolysis and Ethanolysis of Castor Oil Catalyzed by Immobilized Enzymes**

Short introductive summary:

This study aims to compare the efficiency of the transesterification of castor oil with methanol and ethanol as part of the biodiesel production, using immobilized enzyme Lipozyme IM as catalyst. Different reaction conditions were evaluated and optimized, including the reaction temperature, alcohol-to-oil molar ratio, amount of catalyst, addition of water and use of n-hexane as a solvent.

Presenter: **Thalles A. ANDRADE, University of Southern Denmark, Department of Chemical Engineering, Biotechnology and Environmental Technology, Odense M, DENMARK**

Presenter's biography:

I am a chemical engineer and PhD candidate at the University of Southern Denmark working with the castor oil transesterification by means of liquid enzymes as catalyst.

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Session reference: 3AV.4.9

Subtopic: 3.4 Oil-based biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Obtaining Main Components of Liquid Motor Fuels from Sewage Sludge**

Short introductive summary:

Sewage sludge refers to the secondary biomass types. Recently, it is put an emphasis on the recycling of this waste. The main goal of recycling is not only to reduce the accumulated volumes, but also to maximize the extraction of all energy potential in them with minimal ecological damage to the environment. This paper presents the results of an experimental study of the sewage sludge conversion in synthesis gas with its subsequent synthesis into methanol and gasoline fraction. The peculiarity of this method is the possibility of obtaining synthesis gas without gasification, as is customary in the industry now, but by pyrolytic method. As a result of experimental studies, it was found that the methanol after some degree of cleaning will meet the technical methanol of grade B. The gasoline fraction in its original form meets almost all GOST requirements for A-92 gasoline, and after reduction of the aromatic hydrocarbons will meet the ?? ?? 013/2011 requirements for Euro-5 gasoline.

Presenter: **Olga LARINA, Joint Institute for High Temperatures of the Russian Academy of Sciences, Moscow, RUSSIAN FEDERATION**

Presenter's biography:

I graduated from Bauman Moscow State Technical University in 2007. In present time I am PhD-student in Joint Institute for High Temperatures of the Russian Academy of Sciences.

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Session reference: 3AV.4.12

Subtopic: 3.4 Oil-based biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Lab-Scale Bio-Jet Fuel Production and the Scale-Up Evaluation**

Short introductive summary:

This study contains two parts. The first part is to conduct the lab-scale experiments for converting biomass-derived oil into renewable aviation fuel with various operating conditions. The second part is applying the operating conditions and results from the first part and performing the process simulation and techno-economic analysis. The final jet fuel selling price is determined based on the scale-up evaluation.

Presenter: **Wei-Cheng WANG, National Cheng Kung University, Department of Aeronautics and Astronautics, Tainan, TAIWAN**

Presenter's biography:

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North Carolina State University, Raleigh, NC, USA

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Session reference: 3AV.4.13

Subtopic: 3.4 Oil-based biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **The Effect of Economic Variables Over a Biodiesel Production Plant Using Calcium Oxide as a Catalyst**

Short introductive summary:

A process model on calcium oxide catalysed transesterification of acidic oil was designed using superpro designer software. This conceptual process simulation was used to investigate the economic effects of five selected variables such as oil purchasing price, biodiesel selling price, glycerol selling price, alcohol purchasing price and catalyst purchasing price. By changing the values of these variables, it was possible to see how the overall economy of the production process could be affected, with minor change on some of the variables bringing about a considerable effect on the economy, sometimes making it non-profitable option.

Presenter: **Shemelis Nigatu GEBREMARIAM, Norwegian University of Life Sciences, Faculty of Science and Technology, REALTEK, Ås, NORWAY**

Presenter's biography:

Shemelis Nigatu Gebremariam was born in Ethiopia, Addis Ababa on 23/04/78. His B.Sc. Degree is in Agricultural Engineering and Mechanization and his M.Sc. Degree is in Environmental Physics. He has been involved in a number of professional carriers and currently he is PhD fellow at NMBU since 2016.

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Session reference: 3AV.4.15

Subtopic: 3.4 Oil-based biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Improvement of Forest Chip Quality and Supply Chain Performance by Means of a Continuous Quality Measurement System**

Short introductive summary:

This study examines the benefits that a continuous quality measurement of forest chips provides for the power plant utilization and the management of supply chain operations. Continuous quality measurement is based on X-ray scanning of the moving forest-fuel stream, measuring moisture content and impurities such as stones and other foreign matters.

Presenter: **Tapio RANTA, Lappeenranta University of Technology, School of Energy Systems, Lappeenranta, FINLAND**

Presenter's biography:

Tapio Ranta holds a professorship in Bioenergy Economics and has been working in Lappeenranta University of Technology at the School of Energy Systems since 2003. He has specialized in forest biomass supply systems and logistics, biomass markets, and trade.

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Session reference: 1AO.7.1

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Characterisation and Modelling of the Hysteric Compaction-Dilation Relationship for a Range of Biomass Products in Australia and the Pacific Islands

Short introductive summary:

This paper addresses some key areas associated with the challenges facing handling, storage and transportation through physical characterisation and numerical modelling. Materials handling research of biomass products is needed as associated costs form a significant portion of overall operating costs. For instance, feedstock production and logistics can contribute to in excess of 35% of total of cellulosic ethanol production costs, with logistics in moving the biomass from source to conversion making up 50-75% of those costs.<sup>1</sup> In a recent estimate of corn stover feedstock supply in Midwestern U.S., fuel and labour account to around 50% and 60% of the total cost of feedstock transportation (based on trucking) <sup>4</sup>. One critical aspect of biomass valorisation is reduction of transportation costs through the development of efficient logistic systems. This includes reducing capital costs through utilisation of existing logistics systems. Considering the low density per unit mass of biomass feedstock, long distance transportation is not economically feasible unless efficient handling transportation and storage systems are implemented.

Presenter: **Kenneth WILLIAMS, University of Newcastle, Newcastle Institute for Energy and Resources, Callaghan, AUSTRALIA**

Presenter's biography:

A/Prof Williams leads a highly successful research group in the area of bulk materials handling and transportation, which includes biomass feedstocks. He is the research leader of several research projects, which includes multiple aspects of fundamental, industrial and onsite research.

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Session reference: 1AO.7.2

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Solar Enhanced Drying Improving the Woody Biomass Supply Chain

Short introductive summary:

Efforts to mitigate climate change are increasing biomass utilization in several applications. However, sustainable biomass resources are limited, especially regionally. In addition, carbon neutrality of different biomass fractions has been questioned. Through new solar enhanced biomass drying concepts the energy content of sustainable woody biomass resources can be maximized. On the other hand there is an urgent need for low-cost energy storage applications, especially related to solar energy. Decentralized and cheap biomass drying reduces transportation costs and enables distributed energy storage networks. Furthermore, the overall efficiency of energy production increases on one hand, and emissions decrease on the other. The key objective of this paper is to present the key results of the first experiments of the solar enhanced drying system developed by VTT in Jyväskylä, Finland. The first experiments have shown that wood chips can be dried efficiently by solar heat in the developed system. After the system is built, variable operation costs consist mainly on electricity consumed by fans. This cost is compared with economic benefits from drying.

Presenter: **Jyrki RAITILA, VTT Technical Research Centre of Finland, Bioenergy Dpt., Jyväskylä, FINLAND**

Presenter's biography:

Mr. Jyrki Raitila, M.Sc. (For), MA (Global Studies), has over 15 years long experience from developing bioenergy based on solid biomass. He used to lead a team of 15 researchers doing research on solid biomass fuel production & handling at VTT which is the largest research organization in Northern Europe with about 2,600 employees. His expertise covers fuel wood supply chains and business models, particularly with regard to SME heating entrepreneurship, production of wood chips and chopped firewood, and harvesting technology. He has coordinated several national and international bioenergy projects. In addition, he has been in working with international organizations in Europe and beyond for more than 25 years.

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Session reference: 1AO.7.3

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

**Storage of Biomass for Biogas Production: Effect of Ensiling and Co-Ensiling, Biological Additive and Size Reduction**

Short introductive summary:

Storage biomass for biogas production is essential since the biogas plant needs to be fed daily, but the biomass can only be harvested few times per year. Ensiling of biomass is the common method to preservation. However, as a biological process, the effect of ensiling can be affected by many factors. In this study, effect of ensiling duration, additives, pretreatment and co-ensiling with green biomass was investigated using both lab-, pilot- and full-scale ensiling experiment. This study demonstrated that ensiling is essential for biogas production from agricultural by-product or grass. Biological additives elevated both ODM preservation and, as a result, leading to higher BMP. However, it is important to evaluate the total bio-methane potential with consideration of mass losses. The experiment of co-ensiling is still under-going and data will be available in 2018.

Presenter: **Lu FENG, Aarhus University, Department of Engineering, Tjele, DENMARK**

Presenter's biography:

phd student at Department of Engineering, Aarhus University since June, 2015.

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Session reference: 1AO.7.4

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES



**Effect of Biogas Digestate Processing on Fertilizer Value**

Short introductive summary:

The use of biogas digestate as fertilizer is limited by the farm nutrient balance. Mechanical separation and drying of digestate increases the worth of transportation to facilitate nutrient export. However, partitioning of nutrient during fractionation might influence the fertilizer value. This study compared the fertilizer effect of four treatments of biogas digestate: untreated digestate, liquid and solid fraction of separated digestate, and dried separated solid fraction. Pot experiments with barley were performed with two fertilization levels for the different digestate variants. Biomass yield, nitrogen (N) and phosphorus (P) uptake and plant use efficiency were measured.

Mechanical separation and drying of digestate decreased NH<sub>4</sub>-N content in the solid fractions considerably by losses to air. Due to the reduced amount of easily available N, short-term N uptake of barley from solid fractions of digestate was low. It is recommended, that digestate processing should be combined with ammonia recovery, to prevent N losses to environment.

Presenter: **Claudia MAURER, University of Stuttgart, Institute for Sanitary Engineering, Water Quality and Solid Waste Management, Stuttgart, GERMANY**

Presenter's biography:

Since 10/2014 Head of working group "Biological Processes in Circular Economy" at University of Stuttgart  
From 9/2011-9/2014 scientific officer at University of Stuttgart

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Session reference: 1AO.7.5

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Evaluation of the Low-Temperature Corrosion Potential of Flue Gases from the Combustion of Wood and Non-Wood Fuels

Short introductive summary:

The relation between biomass fuel composition and low-temperature corrosion in biomass fired boilers is investigated. Therefore, a series of combustion tests with 10 different biomass fuels (forest residues of good and bad quality, willow, poplar, olive tree and vineyard prunings, olive stones, almond shells, miscanthus pellets and agro-pellets) has been performed at a 50 kW biomass hot water boiler. Downstream the boiler a novel on-line low-temperature corrosion probe was applied. Moreover, a newly adapted method for the determination of the SO<sub>3</sub> content in the flue gas was used. SO<sub>3</sub> is according to experience from coal combustion supposed to be a key factor in acid dew point corrosion due to its capability to form H<sub>2</sub>SO<sub>4</sub>. Additionally, HCl, SO<sub>x</sub>, total dust and PM<sub>1</sub> emissions have been determined. Based on the data gained detailed evaluations regarding the possible corrosion mechanisms prevailing have been derived. The results are of great relevance for the proper design and operation of heat recovery units (economisers, air pre-heaters) in order to avoid/minimize low-temperature corrosion.

Presenter: **Thomas BRUNNER, Bios Bioenergiesysteme, Graz, AUSTRIA**

Presenter's biography:

Studied Chemical Engineering at Graz University of Technology

PhD thesis "Aerosols and coarse fly ashes in fixed-bed biomass combustion—formation, characterisation and emissions" at Eindhoven University of Technology.

Since 1995 project manager at BIOS BIOENERGIESYSTEME GmbH, Graz(AT).

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Session reference: 2AO.8.1

Subtopic: 2.3 Biomass combustion in large utilities

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Deposition Properties of Biomass Fly Ash

Short introductive summary:

Fly ash deposition on boiler surfaces is a major operational problem encountered in biomass-fired boilers. Reducing deposit formation is essential for maximizing boiler efficiency and availability. This study investigated deposit formation of biomass fly ash on steel tubes, in a lab-scale Entrained Flow Reactor. Experiments were conducted using model biomass fly ash, prepared from mixtures of  $K_2Si_4O_9$ , KCl,  $K_2SO_4$ , CaO,  $SiO_2$  and KOH, as well as three different boiler fly ashes: a wood fly ash, a straw fly ash, and a straw + wood cofired fly ash. The fly ashes were injected into the reactor, to form deposits on an air-cooled deposit probe, simulating deposit formation on superheater tubes in boilers. The influence of flue gas temperature (589 – 968 °C), probe surface temperature (300 – 550 °C), flue gas velocity (0.7 – 3.5 m/s), fly ash composition, fly ash flux (10000 – 40000 g/m<sup>2</sup>/h), fly ash particle size (3.5 – 90 µm) and probe residence time (up to 60 min) was investigated.

Presenter: **Yashasvi LAXMINARAYAN, Technical University of Denmark, Chemical and Biochemical Engineering, Kongens Lyngby, DENMARK**

Presenter's biography:

Yashasvi Laxminarayan is a researcher at the Technical University of Denmark, with particular interests in biomass combustion, fly ash deposition and removal in boilers, and catalytic cracking of biomass.

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Session reference: 2AO.8.2

Subtopic: 2.3 Biomass combustion in large utilities

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**The Impact of Aluminosilicate-based Additives upon the Sintering and Melting Behaviour of Biomass Ash**

Short introductive summary:

Utilising biomass for combustion presents a number of challenges, one of which is an often increased rate of deposition. Biomass ash typically contains higher concentrations of alkali-based compounds, with lower eutectic points compared to coal ash, which can become sticky and even molten at high combustion temperatures. One approach to mitigate these issues is to use an additive to increase the concentration of higher melting-point compounds within the ash, which in turn produces weaker deposits. Aluminosilicate-based additives have been shown to promote the conversion of KCl, K<sub>2</sub>SO<sub>4</sub> and KSiO<sub>3</sub> to potassium aluminium silicates.

The aim of the present work is to determine the effect of a waste aluminosilicate additive upon the melting behaviour of three biomass ashes and a power station fly ash. Sinter strength testing has been conducted upon these samples at various sintering temperatures, as well as a range of blends of the ashes and additive, in order to determine the strength of the resulting deposit and the impact of increased additive concentration. Ash fusion testing and SEM/EDX imaging will supplement results, to provide recommendations on additive effectiveness.

Presenter: **Lee ROBERTS, University of Leeds, Chemical and Process Engineering, Liverpool, UNITED KINGDOM**

Presenter's biography:

Lee is a final year PhD student at the University of Leeds Bioenergy Center for Doctoral Training, with a background in physics. His research focuses on the effect of aluminosilicate-based additives upon the deposition and electrical behaviour of biomass used in large-scale power generation.

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Session reference: 2AO.8.3

Subtopic: 2.3 Biomass combustion in large utilities

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Study on Bed Agglomeration, Fouling and Slagging Remedies in Biomass Fired BFB Combustors Based on Laboratory Tests and Long Term Operational Experiences**

Short introductive summary:

Generation of near CO<sub>2</sub> free energy (electricity and heat) in existing large scale co-generation units can be achieved by partial substitution of fossil fuels with biomass commonly regarded as CO<sub>2</sub>-neutral fuel. Fluidized bed boilers are often the technology of choice to combust biomass fuels while bubbling fluidized bed boilers (BFB) are most advantageous for large-scale applications, including utility boilers. The paper presents the study on the impact of the additives on the decrease of agglomeration tendencies as well as slagging and fouling risks. Research was carried out for different biomass blends (wood chips, sunflower husk, willow chips and corn straw chips). As potential additives, mineral, non – renewable compounds: kaolin and halloysite were used while as bed material regular sand, low-silica sand and bottom ash from coal-combustion BFB boiler were compared. Afterwards, an experimental campaign was carried out at two BFB power plants plant to specify the challenges related to fluidized bed combustion of agricultural fuels and demonstrate a technically viable concept for establishing a 20% mass share of agricultural fuel co-fired with woody biomass.

Presenter: **Jaroslav ZUWALA, Institute for Chemical Processing of Coal, Zabrze, POLAND**

Presenter's biography:

Mr. Jaroslav Zuwala holds the positions of R&D Deputy Director and Associate Professor in Institute of Chemical Processing of Coal in Zabrze. He is an experienced researcher&project manager in the field of clean coal technologies, energy storage and biomass and waste based renewable energy.

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Session reference: 2AO.8.4

Subtopic: 2.3 Biomass combustion in large utilities

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Industrial Process Heating: a New Route for Biogas Utilization?**

Short introductive summary:

Traditionally, biogas is used today either to produce electricity or upgraded to natural gas quality and then injected into the natural gas grid. This contribution highlights a possible third route for biogas utilization, the use of roughly pre-treated (i.e. mostly de-sulphurized) biogas in industrial furnaces to provide process heat. This approach could help thermal processing industries (e.g. the glass, metals or ceramics industries to reduce their emission of "fossil" fuels) and at the same time reduce the effort for upgrading biogas.

In a previous project, the usability of "raw" biogas for glass melting was investigated on a semi-industrial scale. The project presented here describes the application of biogas-cofiring in a full-sized regenerative glass melting furnace (firing rate 12 MW) where up to 30 % of the energy input was provided by biogas. It discusses main operational experiences as well as the findings of the accompanying experimental and theoretical investigations in terms of process efficiency, product quality and emissions. In particular, it will provide a closer look at the CO<sub>2</sub> balances of manufacturing process in the thermal processing industries.

Presenter: **Jörg LEICHER, Gas- und Wärme-Institut Essen e.V., Industrial Combustion Technology, Essen, GERMANY**

Presenter's biography:

Research Engineer at GWI since 2009

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Session reference: 2AO.8.5

Subtopic: 2.3 Biomass combustion in large utilities

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Thermo-Catalytic Reforming as Basement for a Novel Biorefining Route to Produce Chemicals and Fuels

Short introductive summary:

Due to the climate targets, new methods are needed to substitute fossil oil or coal. In the biorefinery concept of Fraunhofer UMSICHT waste biomass is converted to chemical products also generated in fossil oil refineries. The biorefinery is developed regarding decentral application.

Presenter: **Nina SCHMITT, Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT, Renewable Energy, Sulzbach-Rosenberg, GERMANY**

Presenter's biography:

I studied chemical engineering at Dresden Technical University. In 2015 I came in contact with the Thermo-Catalytic Reforming process (TCR) at Fraunhofer UMSICHT. In the course of my dissertation I implement deeper studies in the further processing and upgrading of the oil formed by the TCR.

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Session reference: 3AO.9.1

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Screening of Oleaginous Yeasts for Lipids and Pigments Production from Lignocellulosic Hydrolysate

Short introductive summary:

The aim of this study is to select yeasts with high potential to be cultivated in lignocellulosic hydrolysates to produce lipids and pigments. The ability of six yeasts to utilize glucose and xylose was evaluated and lipids and pigments produced during the yeasts cultivation were analyzed and quantified. Obtained results are promising and open up great perspectives for the establishment of a sustainable process for lipid and pigments production using lignocellulosic hydrolysate as carbon source.

Presenter: **Zhijia LIU, Technical University of Denmark, Novo Nordisk Foundation Center for Biosustainability, Copenhagen, DENMARK**

Presenter's biography:

2009-2013 B.Eng, Food Science and Engineering  
Faculty of Chemical Engineering, Kunming University of Science and Technology  
2013-2016 M.Eng, Food Science  
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Session reference: 3AO.9.2

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Process Development of Seaweed Biorefinery

Short introductive summary:

Seaweeds have attracted the attention as a promising candidate of a renewable feedstock as 3rd generation biomass because they can be produced with a similar or higher yield compared to terrestrial energy crops and are less resistant to degradation than terrestrial lignocellulosic feedstocks. However, for developing energetically, economically, and environmentally feasible process for biorefinery of seaweed, integrated research approach including not only deep-understanding and improvement of elemental technology but also the process optimization in consideration of industrial use is needed. Hence, several key technologies for complete utilization of macroalgae were developed including efficient pretreatment, biofuel and valuable chemical production with zero-emission of hazardous materials. Furthermore, the possibility of energy efficiency and economics of seaweed biorefinery will be discussed.

Presenter: **Yutaka NAKASHIMADA, Hiroshima University, Department of Molecular Biotechnology, Higashi-Hiroshima, JAPAN**

Presenter's biography:

Yutaka Nakashimada received Doctorate degree in Chemical Engineering from Nagoya University in 1995. Since 2014 he has been full professor at Department of Molecular Biotechnology, Hiroshima University.

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Session reference: 3AO.9.3

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Boosting the Carbon Efficiency of the Biomass to Liquid Process with Hydrogen from Renewable Power**

Short introductive summary:

The carbon efficiency of a biomass to liquid process is limited by the specific energy content of the feed relative to the product, unless extra energy is added. Hydrogen is an energy carrier and by adding hydrogen to a biomass to liquid process, the carbon efficiency can be increased from ca 35 to more than 90 %, depending on how much energy is added. The production of advanced biofuel can be more than doubled for the same amount of biomass. For the extra production of fuel by adding hydrogen the required electrical power is ca 13 kWh per liter.

Presenter: **Magne HILLESTAD, NTNU, Dept of Chemical Engineering, Trondheim, NORWAY**

Presenter's biography:

I have been conducting activities on CO<sub>2</sub> capturing technologies. I have also research activities on new conceptual designs and evaluation of gas-to-liquid processes, biomass-to-liquid processes (thermochemical) and synthesis gas produced from thermal solar energy through water splitting and CO<sub>2</sub> uti

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Session reference: 3AO.9.4

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

## Reductive Catalytic Fractionation: a Holistic Biorefinery Scheme

Short introductive summary:

Lignocellulosic biomass is an abundant and renewable resource that is mainly composed of cellulose, hemicellulose and lignin. Many existing biorefinery schemes focus on (hemi)cellulose valorisation, leaving the complex lignin fraction as a waste product.

In this contribution, a more holistic biorefinery is proposed which focusses on lignin valorization, while still retaining a processable carbohydrate pulp.

Presenter: **Thijs VANGEEL, KULeuven, Leuven, BELGIUM**

Presenter's biography:

2011-2014: Bachelor of bioscience engineering, KULeuven

2014-2016: Master of bioscience engineering: catalytic technology, KULeuven

2016-present: PhD at KULeuven, Center of surface chemistry and catalysis, promotor: Bert Sels, domain: lignin valorisation

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Session reference: 3AO.9.5

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Comparison of Different Lignin Enzymes

Short introductive summary:

In recent years, there has been a change in the use of fossil resources. There is an increasing awareness for the necessity of an efficient and economic use of renewable raw materials, such as cellulose, hemicellulose and lignin. Especially for cellulose, there is a bounty of applications, a major one of which is producing ethanol. Currently, the usage of lignin is still confined to the production of steam and electricity. Our aim is to produce marketable fragrances and flavourings, such as vanillin and guaiacol from lignin, thus making use of its molecular structure. In order to not override lignin degradation, modest reaction conditions have been chosen, which are most favourably accomplished by the use of enzymes.

Presenter: **Luisa BLAESING, TU Bergakademie Freiberg, Institute of Chemical Technology, Freiberg, GERMANY**

Presenter's biography:  
2012-2018 study of chemistry  
since 2018 PhD

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Session reference: 3AV.5.1  
Subtopic: 3.7 Production and application of biobased chemicals  
Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Improving In-Situ Lipid Extraction Efficiency from Oleaginous Yeast Biomass in a Lipid Extractor for Biofuel Application**

Short introductive summary:

Depletion of fossil fuel over the last few decades has urged the world scientific community to look for alternative renewable fuel sources. Among the various renewable sources available single cell oil from oleaginous yeast is gaining increased attention because of lesser doubling time, higher biomass density, growth independent of climatic conditions and fatty acid composition being similar to vegetable oil. A series of unit steps and operations are involved including biomass cultivation to harvesting, drying, lipid extraction and transesterification to obtain the desired biodiesel. Process intensification in terms of improving the lipid yield and by-passing a few steps in downstream processing is preferable to increase the energy efficiency of the process and to reduce overall cost.

Presenter: **Jayita CHOPRA, IIT Kharagpur, Kharagpur, INDIA**

Presenter's biography:

I am PhD research scholar at the Department of Biotechnology, IIT Kharagpur, India, working in the Bioprocess and Bioproduct Development Laboratory under the guidance of Prof. Ramkrishna Sen. My research interest include yeast fermentation, bio-product development like biodiesel, bio-oil, etc.

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Session reference: 3AV.5.3

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Production of Specialist Chemicals from Bio-Based Short-Chain Fermentation Products

Short introductive summary:

Due to the raw material shift Fraunhofer UMSCHT developed an innovative catalyzed vapour Phase condensation reaction process to produce value-added specialist chemicals from short-chain fermentation products. The products of the process have a wide range of application. They can substitute raw materials for surfactants, special cleaners or cutting oils which are nowadays derived from oleochemical or petrochemical resources.

Presenter: **Martin PETERS, Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSCHT, Biofuels and Biorefinery, Oberhausen, GERMANY**

Presenter's biography:

I was born in 1987. After School I started studying Chemical Engineering at the University of Applied Science "Hochschule Niederrhein" in Krefeld, Germany. After my masters degree I started working on my PhD at Fraunhofer UMSCHT and focused on the research of bio-based fuels and chemicals.

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Session reference: 3AV.5.4

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Chemical Modification of Lignin for The Preparation of Bioplastics**

Short introductive summary:

Kraft lignin was chemically modified including oxypropylation, and then used for bioplastics preparation.

Presenter: **Eun Yeol LEE, Kyung Hee University, Department of Chemical Engineering,, Gyeonggi-do, REPUBLIC OF KOREA**

Presenter's biography:

Dr. Eun Yeol LEE is a professor of Chemical Engineering Department at Kyung Hee University. His research interests are Protein/Metabolic Engineering and Biorefinery for the production of Biofuels, Biochemicals and Biopolymers from lignocellulosic biomass, macro-/microalgae and methane gas.

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Session reference: 3AV.5.8

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Mushroom Biotechnology for Conversion of Lignocellulosic Wastes into Fully Biodegradable Materials and Organic Food**

Short introductive summary:

The main scope of the experiments which are presented in this paper was to achieve the highest and the most complete valorization of lignocellulosic wastes that are come out from forestry and wood processing industry, pomiculture and viticulture, as well as public gardens and green spaces of the cities, through biotechnologies based on their biocoverion by controlled growing of edible and medicinal mushroom species. In this way, there will be produced eco-friendly and fully biorecyclable objects that can be used as packaging, supportive and protective materials at the most competitive prices comparing with the same materials which are produced by non-biotechnological procedures. The innovative biotechnology of lignocellulosic waste bioconversion into eco-friendly and useful products through the controlled growing of mushrooms is based on the use of inoculum obtained by submerged cultivation of mycelia and their development on solid substrates in specific conditions, keeping the strict correlation between parameter values of physico-chemical factors and the biological ones, represented by selected fungal species.

Presenter: **Marian PETRE, University of Pitesti, Nature Sciences, Pitesti, ROMANIA**

Presenter's biography:

Professor Marian Petre, BSc, Ph.D. Habil. in Biological Sciences, graduated Faculty of Biology at Bucharest University in 1981. He is teaching biotechnology for environmental protection, microbiology and bioremediation at the University of Pitesti, Faculty of Sciences. He published over 140 articles

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Session reference: 3AV.5.9

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Challenges in Purifying Proteins from Microalgae

Short introductive summary:

On the submitted poster we will present the challenges that a lot of researchers and industry partners are facing during downstream processing of proteins. Microalgae are well known to accumulate high amounts of proteins and might be more exploited for food and feed in the near future. However, to fully use the technofunctionality of the proteins, they have to be released and isolated from the cells. In this submission we will present techniques from our lab and will discuss the challenges and new techniques for downstream processing of microalgae proteins.

Presenter: **Lutz GROSSMANN, Universität Hohenheim, Food Physics and Meat Science, Stuttgart, GERMANY**

Presenter's biography:

- M.Sc. Food Science and Engineering
- PHD Student in Food Science focusing on microalgae for food purposes

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Session reference: 3AV.5.10

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Efficient Biocatalytic Synthesis of Imidazole-4-Acetic Acid

Short introductive summary:

Imidazole-4-acetic acid (IAA) is a metabolite of histamine having vital biological, pharmacological, physicochemical, and materials science applications. Herein, we describe a new and efficient biocatalytic synthesis of IAA from L-histidine (L-His), featuring the conversion of L-His to imidazole-4-pyruvic acid (IPA) by an *Escherichia coli* whole-cell biocatalyst expressing membrane-bound L-amino acid deaminase (mL-AAD) from *Proteus vulgaris*.

Presenter: **Lehe MEI, Zhejiang University, Department of Chemical and Biological Engineering, Hangzhou, P.R. CHINA**

Presenter's biography:

Education:

2000 Ph. D. in Biochemical Engine, Zhejiang University

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Session reference: 3AV.5.11

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Conversion of Glucose into Valuable 2,5-Diformylfuran by Using Novel Biomass Based Carbon Catalysts**

Short introductive summary:

2,5-diformylfuran (DFF) (a.k.a. 2,5-furandicarboxaldehyde) is a oxidation product of 5-hydroxymethylfurfural (HMF) and can be produced from six-carbon sugars. DFF is a precursor for biopolymer fabrication or can be used as the starting material for the synthesis of drugs. Commonly, DFF is produced from fructose via HMF intermediate. In this study, DFF was produced from more commonly available C6-sugar, glucose, in a one-step process. Reaction was assisted by microwave heating and novel carbon based catalyst were used. Birch sawdust based carbon catalyst were modified to serve this particular reaction by treating the surface of activated carbon with ZnCl<sub>2</sub> and/or HCl and/or H<sub>2</sub>SO<sub>4</sub>. Preliminary results show that these novel catalysts can produce over 40 % DFF yield within 8 h, using only water/THF system, without any traditional homogeneous catalysts. Study is important step towards more environmentally friendly approaches to produce high value added products from biomass.

Presenter: **Annu RUSANEN, University of Oulu, Oulu, FINLAND**

Presenter's biography:

Annu Rusanen (M.Sc.) is a doctoral student at Research Unit of Sustainable Chemistry, University of Oulu, Finland. She graduated in 2015 organic chemistry as her main subject and since then, she has worked in ERDF project PreBio, dealing biomass pretreatment and conversion to value added chemicals.

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Session reference: 3AV.5.16

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Organic Acid Production from Sweet Sorghum Bagasse using Green Chemistry Principles**

Short introductive summary:

Organic acids, such as succinic and lactic, are used extensively in chemical manufacturing for a wide range of products, including plastics, resins, coatings, films, and lacquers. They are manufactured predominantly from petrochemicals (succinic) or food crops (lactic), but as the drive towards a green economy intensifies, there is strong interest in sustainably manufacturing such compounds from inedible renewable resources, such as cellulosic biomass. In this study we investigated the biochemical conversion of sweet sorghum bagasse to organic acids using green chemistry principles for the pretreatment of biomass, followed by enzymatic hydrolysis to cellulosic sugars, and fermentation of the sugars to succinic and lactic acid by *Actinobacillus succinogenes*.

Presenter: **George PHILIPPIDIS, University of South Florida, Patel College of Global Sustainability, Tampa, USA**

Presenter's biography:

Dr. George Philippidis is Associate Professor at the University of South Florida with expertise in the biomass and algae industries. He has held leadership positions in the private and public sectors and holds a Ph.D. in Chemical Engineering and an MBA.

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Session reference: 3AV.5.18

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Determining Factors for Vanillin Yield in Oxidative Solvothermal Conversion of Lignin in a Two-Phase System**

Short introductive summary:

Lignin keeps being the subject of intense research as it can be converted to green fuels and aromatic chemicals. Solvothermal processes are an alternative to pure thermal techniques (such as pyrolysis) offering the potential to use significantly lower temperatures for lignin conversion. The aim of this work is to identify and investigate those factors relevant for the solvothermal lignin depolymerization at both pH 1 and 14 using oxygen as the oxidant. Therefore, we systematically screened experimental conditions (i.e. temperature, pH, reaction time, stirring speed, lignin concentration), and the type of technical lignin within the same oxidative method. Vanillin was used as target product and an unambiguous analytical method for vanillin quantification was established. Vanillin yields were used as indicators for assessing the impact of a given experimental factor on the oxidative method. The goal was not to achieve the highest possible yield in vanillin, but rather in determining what factors are relevant in the oxidative solvothermolysis of technical lignins.

Presenter: **Saša BJELIC, Paul Scherrer Institut, Energy and Environment, Villigen PSI, SWITZERLAND**

Presenter's biography:

Saša Bjelic obtained his PhD in 2008 at the University of Zurich. He established state-of-the-art analytical laboratory focusing on high resolution mass spectrometry in the department of Energy and Environment. The focus is analytics of renewable energy (bio-oils) and fine chemicals from lignin.

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Session reference: 3AV.5.19

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Glycolaldehyde as a Bio-Based Platform Molecule for Reductive Amination Reactions

Short introductive summary:

Glycolaldehyde has great potential to act as a renewable platform molecule in the near future. Here, we present a route towards bio-based alkanolamines and diamines from glycolaldehyde.

Presenter: **William FAVEERE, KU Leuven, Centre for Surface Chemistry and Catalysis, Heverlee, BELGIUM**

Presenter's biography:

William Faveere obtained his Master's Degree in Bio-Engineering - Catalysis in 2014 at KU Leuven. He is currently working on his PhD on the use of bio-based glycolaldehyde as a platform molecule under the supervision of Prof. Bert Sels.

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Session reference: 3AV.5.20

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Burning Wood Pellets for US Electricity Generation? A Regime Switching Analysis**

Short introductive summary:

Applying a regime switching model under the theoretic framework of real options, we inspect the optimal timing boundaries for coal and coal mixed with wood pellets as two alternative fuels for a power plant in Georgia, United States. Results indicate that cofiring wood pellets with coal is generally not a commercially viable option. However, lower-level (with wood pellets less than 15%) cofiring could have been feasible during the infancy period (2009-2011) when wood pellet price was declining. Sensitivity analysis shows that our conclusions are robust and the most important factors are relative prices of coal and mixed fuel. Therefore, we reject the null hypothesis that cofiring is economically feasible and suggest using policy vehicles to stimulate the bioenergy market and meet the greenhouse gas emission reduction target. In particular, a subsidy of \$1.40/mmbtu to the 10% mixed fuel or a tax of \$1.50/mmbtu on coal would prompt the conversions of coal-only power plants to cofiring ones, and a subsidy of \$0.45/mmbtu to the 10% mixed fuel or a tax of \$0.50/mmbtu on coal would maintain existing cofiring power plants in the status quo

Presenter: **Bin MEI, University of Georgia, Warnell School of Forestry & Natural Resources, Athens, USA**

Presenter's biography:

Associate Professor, University of Georgia

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Session reference: 4AV.6.3

Subtopic: 4.1 Market implementation, investments & financing

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## How to Enhance the Economic Viability of Straw Based Heating Plants in Germany?

Short introductive summary:

In this study a scientific evaluation of different heating plants utilizing straw (and hay) is intended to provide indicators for the improvement of profitability and sustainability of the whole value chain – from the supply of raw material to the reasonable use of heat and electricity. In addition, objective criteria will be determined to serve as decision-making aid for the proposed investments. Therefore, six plants will be surveyed, which represent a certain range of different plant concepts. This provides a data set for assessing existing plant configurations at various levels and for the development of further statements in a higher level context. First results of this study demonstrate a high economic efficiency of straw and hay based heating plants in the output range of 0.5 to 1 MW, which is mainly associated to a high capacity of utilization. In contrast, other studies showed a low economic efficiency of straw based heating plants. This highlights the need to deliver pertinent information as a basis for targeted decision-making for future investors in straw or hay based heating plants in Germany.

Presenter: **Telse VOGEL, Dummerstorf, GERMANY**

Presenter's biography:

Since 06/2017 Research assistant, State Research Center of Agriculture and Fisheries Mecklenburg-Vorpommern. Since 10/2009 Doctoral studies, University of Rostock. 2007-2009 Research assistant, University of Applied Sciences Stralsund. 2000-2006 Studies of landscape ecology, University Rostock.

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Session reference: 4AV.6.4

Subtopic: 4.1 Market implementation, investments & financing

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY



## **Evaluation of Competitiveness of Locally Available Biomass for Decentralized Space Heating In Villages and Small Towns**

Short introductive summary:

The contribution presents the methodology and case study in condition of the Czech Rep. of BICOM - Biomass COmpetitiveness Model for modelling and evaluation of competitiveness of locally available biomass for decentralized space heating in villages and small towns.

Presenter: **Jan WEGER, Silva Tarouca Research Institute for Landscape, Phytoenergy and Biodiversity Dpt., Pruhonic, CZECH REPUBLIC**

Presenter's biography:

Jan Weger is bioenergy researcher since 1996. Main research interests include selection and breeding of biomass crops (esp. poplar, willow, Miscanthus), agronomy and ecological aspects biomass production and modeling of energy and economic potential of biomass in the landscape using GIS.

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Session reference: 4AV.6.5

Subtopic: 4.1 Market implementation, investments & financing

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

**Market Share Estimation of Biomethane and Promising Business Opportunities in Germany Using a System Dynamics Modelling Approach**

Short introductive summary:

We have developed a Biomethane Market Simulation Model (BiMaSiMo) (both anaerobic and thermochemical biomethane) for the case study of Germany using a quantitative bottom-up modeling approach. Whereas the focus of the past decade was on modeling the transition of the energy sector our modeling approach deals with biomethane in the power, heat and fuel market. Renewable gas will play a major role for the upcoming flexibility demand due to the increased installation of volatile renewables like wind and solar power. Incentive schemes in the past 12 years led to a mature market with about half of the installed biomethane producing capacity of Europe simultaneously affecting technological progress and the installation of comparable supporting schemes in Europe. What's currently missing in the research literature is a model that encompasses the power, heat and fuel markets for a renewable biogenic energy carrier. Without the sectors heat and fuel the energy transition will not be successful.

Presenter: **Thomas HORSCHIG, DBFZ-German Biomass Research Centre, Bioenergy Systems Dpt., Leipzig, GERMANY**

Presenter's biography:

Thomas Horschig. Work experience: 01/2014 - 10/2017 PhD Student @ DBFZ Deutsches Biomasseforschungszentrum. From 11/2017 on Research Fellow @ DBFZ Deutsches Biomasseforschungszentrum gGmbH, Leipzig. 2011 - 2013 University Halle-Wittenberg. M. Sc. Management of Natural Resources.

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Session reference: 4AV.6.7

Subtopic: 4.1 Market implementation, investments & financing

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

**Potential Advantages in Heat and Power Production when Biogas is Collected from Several Digesters Using Dedicated Pipelines - A Case Study in the Province of West-Flanders (Belgium)**

Short introductive summary:

In the case study in "West Flanders" costs of electricity and heat are calculated if a dedicated biogas grid using pipelines would be implemented to centralize electricity and heat production using a combined heat and power (CHP) installation. Heat may not be used effectively at digester sites, e.g. because of a change in treatment of digestate. A large scale centralized CHP can produce additional electrical power at a hub and at lower specific costs compared to decentralized CHPs. The CHP scale advantage in costs is quantified and with biogas transport costs attributed to additional electrical energy (80%) and heat (20%). For this study a biogas transport model is used to calculate transport costs in a grid. Costs of additional electricity can be as low as 4.0 €ct kWh<sup>-1</sup> and are almost always below 12 €ct kWh<sup>-1</sup>. Additional costs of heat produced at the hub show to be lower than 1 €ct kWh<sup>-1</sup> assuming an effective heat use of 50%. When a hub is located at a heat sink, more renewable energy is produced and optimally used, i.e. a more efficient use of biomass feedstock. It is concluded that scale advantages in a CHP can be a driver to collect biogas at a hub.

Presenter: **Evert Jan HENGVELD, Hanze University of Applied Sciences / University of Groningen, Hanze Research Centre Energy, Groningen, THE NETHERLANDS**

Presenter's biography:

Evert Jan Hengeveld, MSc in Physics, holds a position as researcher and lecturer at the Hanze UAS in Groningen (NL). The focus of the research is on modeling of a Biogas Infrastructure with a biogas grid.

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Session reference: 4AV.6.8

Subtopic: 4.1 Market implementation, investments & financing

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

**Climate vs Biomass Sustainability Targets: Are They Compatible under a Well Below 2 °C Trajectory?**

Short introductive summary:

In the light of the Paris Agreement, aimed at keeping the global temperature rise to well below 2°C as compared to pre-industrial levels, Bioenergy with Carbon Capture and Storage (BECCS) could feature an even more important role than previously suggested. Yet the magnitude of the “negative emissions” delivered by BECCS depend on the availability and sustainability of biomass resource. We explore these uncertainties by using the TIAM-UCL multi-region IAM. Focusing on two countries, the UK and Romania, we compare TIAM-UCL results to national biomass resource and GHG risk assessments. Our results suggest that the sustainability criteria are limiting for bioenergy development in both countries but especially for the UK, which relies heavily on biomass imports. We argue that a globally harmonised definition of sustainability criteria for biomass resource is needed.

Presenter: **Isabela BUTNAR, University College London, Institute for Sustainable Resources, London, UNITED KINGDOM**

Presenter's biography:

Chemical engineer by background, I have 16 years expertise in modelling environmental impacts associated with agricultural supply chains, both within academia and the industry. My main expertise is LCA and energy systems modelling, in particular global bioenergy value chains modelling.

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Session reference: 4AV.6.9

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **The Importance of Quantifying Soil Carbon Storage at Outset of Perennial Energy Crops: a Case Study.**

Short introductive summary:

A proper quantification of the soil carbon storage for perennial energy crop is often problematic. On the one hand, many years are required to observe relevant soil organic carbon accrual. On the other hand, for several multi-year experiment no soil samples are available for the outset of the experiment. Then, the only possibility is to compare the soil organic carbon storage of a perennial crop after given years from planting, with a nearby arable soil. The common assumption is that soil characteristics are fairly uniform across a limited area. I here present a case study data indicating that soil carbon might vary substantially even within the same field.

Presenter: **Enrico CEOTTO, CREA- Council for Agricultural Research and Economics, Research Centre for Agriculture and Environment, Bologna, ITALY**

Presenter's biography:

Enrico Ceotto is Senior Researcher Agronomist at the Research Center Agriculture and Environment, located in Bologna, Northern Italy. Currently, his research activity is focused on perennial energy crops and their ecosystem services. E-mail address: [enrico.ceotto@crea.gov.it](mailto:enrico.ceotto@crea.gov.it).

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Session reference: 4AV.6.12

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Evaluation of the Climate Benefit in Complex Biorefinery Systems: when a Dynamic Modeling Becomes Crucial**

Short introductive summary:

To provide better and more extensive impact assessments, the evaluation of climate change mitigation potential from the production of fuels from conventional biomass has recently evolved, mainly by: i) incorporating a dynamic approach; ii) including comparison with the reference system; iii) explicitly accounting for all CO<sub>2</sub> flows, including biogenic-C. In this study, examples of complex biorefinery systems are presented applying these methodological innovations to contribute to a better understanding of the potential climate benefit achieved by the production of bioenergy and bio-based products. The case studies analysed are based on the use of municipal solid waste (MSW) for the production of bio-fuels and bio-chemicals including the use of carbon capture and storage technology (Bio-CCS).

Presenter: **Pedro HARO, Universidad de Sevilla, Chemical and Environmental Engineering, Seville, SPAIN**

Presenter's biography:

Pedro Haro is a post-doc researcher at the Bioenergy Group since 2015. His main research topic is the design and assessment of thermochemical biorefineries and waste-energy systems. He has collaborated with several research centers for the evaluation of pre-commercial and demonstration projects.

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Session reference: 4AV.6.13

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Life Cycle Co2 Emission Reduction in Nordic Integrated Steel Plant by Applying Biomass-Based Reducing Agents**

Short introductive summary:

The use of biomass in iron and steelmaking as a reducing agent or as a source of energy has been identified as one of the possible solutions to reduce the fossil CO<sub>2</sub> emissions of this carbon intensive industry. Up to date there is very little knowledge concerning the CO<sub>2</sub> emission reduction potential of using biomass-based fuels in iron and steelmaking processes. In this research, a life cycle CO<sub>2</sub> analysis is made to compare life cycle CO<sub>2</sub> emission profile of steel production in Nordic integrated steel plant to different biomass scenarios in which pulverized coal injection to the blast furnace is partially or completely replaced with biomass-derived reducing agents.

Presenter: **Chuan WANG, Swerea MEFOS, Lulea, SWEDEN**

Presenter's biography:

Dr. Wang has been working at Swerea MEFOS for more than 10 years with focus on CO<sub>2</sub> emission reduction, energy and material efficiency improvement. Chuan Wang has been working on several biomass projects, for instance, utilizing biomass for the steel industry.

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Session reference: 4AV.6.14

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Climate Impact of Advanced Aviation Fuels Based on Hydrogenated Vegetable Oils

Short introductive summary:

For the rapidly growing aviation sector, the national climate protection targets and the international voluntary commitment to reduce GHG emissions represent an enormous challenge. Sustainable, renewable kerosene with correspondingly high specific GHG reductions could play a key role in achieving these targets. Among the conceivable options for the provision of advanced aviation fuels, the production of kerosene via the Power-to-gas-HEFA process based on vegetable oils is commercially implemented and thus a short-term option to provide bio-kerosene in significant quantities.

In this presentation, we will discuss the GHG emissions associated with the production of kerosene from hydrated vegetable oils with special focus on a sensitivity analysis regarding the feedstock provision, the hydrogen production, the electricity provision and the refinery location. The results presented have been created as part of The Mobility and Fuels Strategy of the German Government (MFS).

Presenter: **Katja OEHMICHEN, DBFZ-German Biomass Research Centre, Bioenergy Systems Dpt., Leipzig, GERMANY**

Presenter's biography:

Katja Oehmichen has joined the DBFZ in 2008. Since 2012 she is part of the department Bioenergy systems. Her expertise is carbon footprinting of biofuels and bio-based materials and the development and standardisation of methodologies for sustainability assessment.

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Session reference: 4AV.6.15

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY



## Carbon Footprinting for Biomethane in the EU RED and EU ETS Context

Short introductive summary:

Biomethane is considered as an interesting option to reduce GHG emissions in a number of applications. In the EU ETS as well as in the EU RED framework, biomethane is competing with various other GHG mitigation measures and renewable energy carriers. In this presentation, we discuss, to which extent the price for CO<sub>2</sub> certificates in the EU ETS system can contribute to close the gap between the costs of biomethane production and fossil reference products such as natural gas. The results presented have been created as part of the EU H2020 project BIOSURF. To address the most important political instruments for the promotion of renewable energy carriers on EU level, we have calculated the GHG mitigation costs for biomethane compared to natural gas from three perspectives.

Presenter: **Stefan MAJER, DBFZ-German Biomass Research Centre, Biofuels Dpt., LEIPZIG, GERMANY**

Presenter's biography:

Stefan Majer has joined the German Biomass Research Centre in 2007. His research interest focuses on the life cycle and sustainability assessment of current and future bioenergy options. In this context he is responsible for different LCA case studies and the development of approaches for the optim

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Session reference: 4AV.6.17

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **A Bioenergy Integrated System with a Process Oriented Lca Modelling Approach**

Short introductive summary:

In traditional life cycle assessment (LCA) models, systems and technologies are often modelled as black box without any input-output relationship. This study describes a process oriented modelling approach applied to a bioenergy integrated system, subdivided in its operated unit processes. Preliminary results of a consequential LCA are shown.

Presenter: **Concetta LODATO, Technical University of Denmark, Environmental Engineering Dp., Kgs. Lyngby, DENMARK**

Presenter's biography:

Concetta Lodato is a PhD student at the Technical University of Denmark (DTU), Department of Environmental Engineering. Her research field is life cycle assessment modelling of bioprocesses using dedicated tools.

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Session reference: 4AV.6.18

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Assessing Carbon Footprint of a Full-Scale Anaerobic-Based Sewage Treatment Plant

Short introductive summary:

The aim of this work was to assess the carbon footprint of a full-scale sewage treatment plant (12,000 PE) comprised by a UASB reactor followed by a trickling filter. Three different scenarios were simulated taking into account the integrated management of biogas and sludge: (1) estimated biogas production was directly burned without energy recovery and the excess sludge was routed to drying beds and then disposed of in landfill; (2) 100% of the estimated biogas production was considered for sludge sanitization, which would be used for agriculture in the STP vicinity; and (3) similar to scenario 2, nevertheless the management of dissolved gases was taken into account. Total carbon emissions of the assessed scenarios were equivalent to approximately 677, 554 and 126 tCO<sub>2</sub>,equiv.year<sup>-1</sup>, respectively. The carbon footprint reduction of approximately 81% between scenarios 1 and 3 was mainly related to the management of diffuse emissions, via a simple degassing unit followed by a biofilter.

Presenter: **Carlos CHERNICHARO, Universidade Federal de Minas Gerais (UFMG), Department of Sanitary and Environmental Engineering, Belo Horizonte, BRAZIL**

Presenter's biography:

Full professor at the Department of Sanitary and Environmental Engineering - Universidade Federal de Minas Gerais (UFMG), Brazil. Currently he coordinates the National Institute of Science and Technology on Sustainable Sewage Treatment Plants.

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Session reference: 4AV.6.19

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Torrefied Medical Cotton Waste for Industrial Liquid Waste Cleaning**

Short introductive summary:

The results showed that torrefaction treatment of cotton enhances its adsorption properties considerably. Lagergren, pseudo-second-order and intraparticle diffusion kinetic models were applied to fit the experimental data. Thus, this low cost adsorbent could be made widely available for use as an alternative to commercial activated carbons for the removal of basic dyes like Methylene Blue from wastewater effluents.

Presenter: **George GIAKOUMAKIS, Univ. Piraeus, Research Center, Industrial Management and Technology, Piraeus, GREECE**

Presenter's biography:

Chemical Engineer with an MBA. PhD student in the University of Piraeus, Department of Industrial Management and Technology. Born in 1987.

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Session reference: 4AV.6.23

Subtopic: 4.5 Resource efficient bioeconomy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Will Dried Sludge from Fish Farming Become a Contributor or Competitor to the Utilization of Municipal Sludge?**

Short introductive summary:

Production of Nordic Salmon has become an industry with continuous growth and the aim to exceed oil and gas in terms of Norwegian export value in 2030.

This rapid growth in a traditional farm based production has required need for regulations and technical solutions in order to handle both waste water treatment and sludge handling.

Scanship has successfully transferred technical solutions from waste handling at cruise ships to the land based fish farming. The solution is dewatering and drying of sludge to a stable bi-product. This will reduce transport cost and make it possible to storage the product over longer periods in the remote fjord areas of the Norwegian west coast.

As part of the solution Scanship has established collaboration with end users for the reuse of sludge as a bi-product. The different areas where the bi-product has become a value are within fertilizer, biogas and incineration.

The nutritious rich product with high energy content makes it a high-quality sludge.

Presenter: **Lars ROHOLD, Scanship, Aquaculture, Tønsberg, NORWAY**

Presenter's biography:

Lars Rohold has been working within aquaculture since 2014 both with water treatment and sludge handling in Krüger Kaldnes AS. Last year Lars Rohold started at Scanship AS with market focus on sludge handling for fish farming. Working experience with sludge handling and biogas plants for 20 years

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Session reference: 4AV.6.24

Subtopic: 4.5 Resource efficient bioeconomy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Remote sensing quantification of methane emissions from 10 biogas plants in Denmark and Germany**

Short introductive summary:

A remote sensing method was used to quantify total methane emission from 10 biogas plants. The average emission corresponded to 2% of the biogas production, but large variation was observed.

Presenter: **Anders Michael FREDENSLUND, Roskilde University, ROSKILDE, DENMARK**

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Session reference: 4AV.6.25

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Combustion Quality of Paludi Pellets after DIN EN 14961-6 from rewetted fens in Northeastern Germany

Short introductive summary:

Paludiculture is the sustainable use of wet and rewetted peatlands. In comparison to a drainage-based agriculture it preserves the peat body by decreasing decomposition processes in the peat and therewith reduces greenhouse gas emissions. The biomass from Paludiculture can be used for energy – as a solid biofuel for heating.

Biofuels have to meet quality standards to minimize pollution and technical damage to the boilers (Tab. 2). This study<sup>1</sup> examines quality parameters of Paludi pellets with respect to DIN EN 17225-62, that gives standards for non-woody biomass pellets that are recommended for the trade and use in Europe. In this study different biomass types were tested.

Presenter: **Claudia OEHMKE, University Greifswald, Institute of Botany and Landscape Ecology, Greifswald, GERMANY**

Presenter's biography:

Diploma of Landscape Ecology

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Session reference: 4AV.6.29

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Best Available Technologies for Pruning Harvesting

Short introductive summary:

Farmers consider pruning (branches and shoots of the fruit trees) a problem rather than an opportunity and, hence, it is unused or disposed incorrectly. However, the formulation of more strict regulations for the handling of the pruning in most European countries led to a renewed interest in pruning recovery.

The harvesting stage represents a key point that influences the product quality, the type of logistic chain and the economic sustainability of the pruning supply chain and, over the years, many machine manufacturers invested in the development of dedicated implements for collecting pruning residue. Equipment able to facilitate the harvest and processing of agricultural pruning are already available in the market and many machinery builders propose different models to be adapt to various harvesting logistic chains.

The purpose of this study is to provide a thorough overview of technologies available to harvest pruning, from the more basic equipment until the most integrated approach.

Presenter: **Luigi PARI, CREA- Council for Agricultural Research and Economics, Centro di ricerca Ingegneria e Trasformazioni agroalimentari, Monterotondo RM, ITALY**

Presenter's biography:

Dr. Luigi Pari has a PhD in Agricultural Engineering in 1990 and start working as researcher in the Agricultural Engineering Unit (CRA-ING) of the Agricultural Research and Experimental Council (CRA), in Monterotondo (Roma). In 2002 he became Scientific Director of the Non Food Agriculture - Energy Crops Group (PANACEA), coordinating the activities of 18 researchers, which main activity is to develop new agricultural machineries prototype for energy crops harvesting and logistic.

Authors of more than 200 scientific publications, he was scientific responsible of more then 30 research projects, funded by European Union, Italian Ministry of Agriculture and private enterprises

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Session reference: 1BO.1.1

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES



**Field Performance of Forage Harvesters and A Mower-Chipper for Harvest of Short Rotation Coppices**

Short introductive summary:

Restrictions in availability, performance and high cost of harvest machines for wood from agriculture produced in plantations of short rotation coppices are still limiting factors for the further growth of this branch. Three different harvest systems – two of them based on modified forage harvester and one mower-chipper - have been investigated during the harvest of poplar and black locust in Germany in the years 2015 to 2017. Although there are major differences in machine design, requirements to the layout of plantations, maximum harvestable tree size and performance of these machines, no major differences in the effective material capacity (EMC) between forage harvester based solutions and the mower-chipper could be observed during the harvest tests (EMC approx. 16 odt h<sup>-1</sup>). However, forager harvesters produced much smaller chips (class P16 to P31) with a higher content of fines (15%). Wood chips produced with the mower-chipper have been much coarser (class P31 to P45) with a very low content of fines (5 to 7%). All tested harvesters showed reliable operation under practice conditions and are commercially available now.

Presenter: **Ralf PECENKA, Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB), Post Harvest Dpt., Potsdam, GERMANY**

Presenter's biography:

Dr. Ralf Pecenka works as a researcher at the Leibniz Institute for Agricultural Engineering and Bioeconomy(ATB), Germany. His main research subjects are harvest, storage and processing of short-rotation woody crops. Further information: [www.atb-potsdam.de](http://www.atb-potsdam.de)

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Session reference: 1BO.1.2

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

**Adaptions of Harvesting Methods and Concepts in order to Reduce Weeds on Agricultural Fields and to Gain Potentially a So Far Unexploited Biomass Feedstock**

Short introductive summary:

Sweedhart is a transnational research project funded in the frame of the ERA-NET Cofund FACCE SURPLUS, which is formed in collaboration between the European Commission and a partnership of 15 countries in the frame of the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI). FACCE SURPLUS is committed to improve collaboration across the European Research Area in the range of diverse, but integrated, food and non-food biomass production and transformation systems, including biorefining. Within the project Sweedhart different measures and concepts with regard to harvesting are investigated in order to reduce weeds on agricultural fields without using herbicides. During harvesting three main fractions are normally produced – grain, chaff with weed seeds and straw. Conventional combine harvesters return the chaff and weed seeds to the fields and the seeds become a problem in future growing seasons. Sweedhart aims to remove that fraction from the field and to utilize it energetically and/or materially and also explores the possibility to kill the weed seeds on the combine harvester before the fraction is returned to the field.

Presenter: **Christoph GLASNER, Fraunhofer UMSICHT, Biomass and Residues Utilization, Oberhausen, GERMANY**

Presenter's biography:

Since 2009 he is research assistant at Fraunhofer UMSICHT in the field of biomass conversion and water treatment/management. Currently, he is responsible for international projects in the field of food processing and biomass utilization.

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Session reference: 1BO.1.3

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Valorizing Nutrients from Pome Digestate

Short introductive summary:

Palm Oil Mill Effluent (POME) is considered a problematic waste, causing pollution problems: methane emission, water pollution with organic material (BOD) and nutrient pollution. POME is well suited for treatment in digestion tanks. Anaerobic digestion (biogas production) followed by energy production solves the methane problem and reduces BOD pollution. Using inorganic components (minerals) in the treated POME (POME digestate) as a fertilizer in the plantation could contribute significantly to the economic viability of digestion systems, while reducing environmental impacts of palm oil mills.

Presenter: **Julien VOOGT, Wageningen Food and Biobased Research, Wageningen, THE NETHERLANDS**

Presenter's biography:

Scientist at Wageningen Food and Biobased Research

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Session reference: 1BO.1.4

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

**Horse Manure as Feedstock for Renewable Energy and Recycling of Nutrients - Biogas from Horse Manure**

Short introductive summary:

Recovery of energy and nutrients from horse manure contribute to an increased share of renewable energy, circular economy and reduced greenhouse gas emissions. Our studies highlights the energy potential and associated environmental impact of composting, anaerobic digestion and incineration of horse manure. Emphasis is on anaerobic digestion due to its high degree of resource conservation, both in terms of energy (biogas) and nutrients (biofertilizer). The potential is to different extent dependent on e.g. the type and content of bedding, amount of horse manure, and temperature and retention time in the digester. Anaerobic digestion was indicated to reduce global warming potential in comparison to incineration and composting while large scale incineration, without nutrient recovery, indicated lower eutrophication and acidification potential, and energy demand. Anaerobic digestion in a centralized plant reduced environmental impact in comparison to composting on site, but was indicated to create higher costs for horse keepers.

Presenter: **Asa HADIN, University of Gävle, Department of Building, Energy and Environmental Engineering,, Gävle, SWEDEN**

Presenter's biography:

I am a PhD-student in Energy systems at the University of Gävle, and as I am in the final phases of my studies it would be interesting to share the results and have input from other researchers in the EUBCE conference 2018. My research area is renewable energy from horse manure, focus biogas.

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Session reference: 1BO.1.5

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Use of Gasification Char for Hot Gas Filtration in Micro-Scale Power Plants

Short introductive summary:

This work investigates the capability to design and fabricate compact dry filters for gasifier power plants. The filter are produced using the same charcoal disposed by the gasifier. A candle filter design is used here in 40 hours test.

Presenter: **Giulio ALLESINA, BEELab (Bio Energy Efficiency Laboratory), Enzo Ferrari Engineering Dpt., Modena, ITALY**

Presenter's biography:

Giulio Allesina holds a master's degree in Mechanical Engineer and a PhD in "High Mechanics and Automotive Design & Technology" discussing a final thesis on "Experimental and analytical evaluation of stratified downdraft gasifiers." His research and teaching focuses on renewable sources.

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Session reference: 2BO.2.1

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Enhancing the Gas Quality and Hydrogen Yield from Air Gasification of Corn Straw Pretreated by Anaerobic Digestion Process**

Short introductive summary:

Anaerobic digestion (AD) was applied as pretreatment for lignocellulosic biomass gasification, and this method did improved the fuel gas quality and hydrogen yield during gasification process. Besides, the mechanism of the phenomenon was also investigated in detail. This finding would contribute to the better integration of AD and thermo-gasification process.

Presenter: **Xiang GUO, Tianjin University, Environmental engineering Dpt., Tianjin, P.R. CHINA**

Presenter's biography:

I am a PhD. student from Tianjin University, focouse on the investigation on integration of anaerobic digestion and thermo-gasification technologies.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 2BO.2.2

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Novel Extension of Biomass Poly-Generation to Small Scale Gasification Systems in South-Tyrol**

Short introductive summary:

Small-scale gasification technologies have rapidly grown in the last years, representing a viable alternative for the exploitation of woody residues and their transformation into valuable materials, such as the syngas. However, the thermochemical process implemented in these technologies has some solid and liquid by-products that have to be managed. In order to get insights on possible pathways for their exploitation and valorization, the NEXT GENERATION (i.e., Novel EXTension of biomass poly-GENERATION to small scale gasification systems in South-Tyrol) project was implemented. The project, funded by the Autonomous Province of Bolzano, ideally represents the follow-up of the GAST (i.e., "Gasification in South-Tyrol: energy and environmental assessment") project, in which the most representative gasification technologies were investigated, monitored and assessed for their performance. Thus, the main aim of the NEXT GENERATION project was to investigate the quantity, quality and environmental impact of the gasification by-products and to assess possible routes for their valorization, according to the concept of poly-generation.

Presenter: **Marco BARATIERI, Free University of Bolzano, Faculty of Science and Technology, Bolzano, ITALY**

Presenter's biography:

Associate Professor in Thermal Engineering and Industrial Energy Systems at the Free University of Bolzano (Italy). M.Sc. and Ph.D. in Environmental Engineering, his main research field is thermochemistry of biomass gasification and pyrolysis.

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Session reference: 2BO.2.3

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**One Month Daily Start and Stop Supercritical Water Gasification Test Plan for Residue of Shochu (Japanese Distilled Liquor) to Create Renewable Energy**

Short introductive summary:

Shochu is Japanese traditional distilled liquor, and Shochu residue by-produced in distillation process is biological effluent and a kind of wet-biomass. Shochu residue's disposal cost is very high, because of its property as too easy to rot, too heavy to transport, and too wet to burn. Generally, utilization of wet-biomass is difficult and a terrible putrefaction odor is an obstacle to processing, storage and transportation.

Supercritical water gasification (SCWG) for wet-biomass holds promise as a technology to convert wet-biomass into valuable fuel gas. The pre-drying and dehydration process are unnecessary for SCWG treatment, because of using water as a solvent for SCWG reaction.

SCWG process for shochu residue can provide steam for distillation and fermentation process in distillers' factories; moreover shochu residue has been treated to clear water with SCWG technology. Plug problem with tar at heat exchanger as important apparatus for SCWG running cost saving was concerned for commercial plants, however 60 h DSS SCWG test was succeeded by Radical Scavenger and Rapidly Temperature Rising, last year. Therefore, for practical use in Distillers' factory, One month DSS (Daily start and stop) SCWG test is planned for next step with remodeled pilot plant which has 1 wet-t/d treatment ability as Japanese national project of NEDO.

Presenter: **Yasutaka WADA, The Chugoku Electric Power, Energia Economic & Technical Research Institute, Higashihiroshima, JAPAN**

Presenter's biography:

Yasutaka WADA is a PhD and a P.E.Jp. He works for Chugoku Electric Power Co., Inc. and works with Renewable Energy Technology, especially Supercritical Water Gasification Technology for wet-biomass.

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Session reference: 2BO.2.4

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



**Development of a New Highly Efficient and Fuel Flexible Medium-Scale CHP Technology Based on Fixed-Bed Updraft Biomass Gasification and a SOFC**

Short introductive summary:

Within the Horizon 2020 project "HiEff-BioPower" a new highly efficient biomass CHP technology is developed for a capacity range of 1 to 10 MW (total energy output). It consists of (i) a fuel-flexible fixed-bed updraft gasifier, (ii) a novel compact gas cleaning system for dust, HCl and S removal as well as final tar cracking within one process step, (iii) a solid oxide fuel cell (SOFC) and (iv) a heat recovery system which supplies heat for internal heating purposes and for external utilisation. The technology shall distinguish itself by a wide fuel spectrum applicable (wood pellets, wood chips, short rotation coppice (SRC), selected agricultural fuels like agro-pellets, fruit stones/shells), high gross electric (40%) and overall (90%) efficiencies as well as equal-zero gaseous and PM emissions.

At the conference the results of first test runs performed at a testing plant consisting of a 400 kW gasifier, the gas cleaning unit and a 6 kWel slip stream SOFC system shall be presented, focusing on the determination of the product gas quality as well as an outlook on the expected SOFC performance (determined during lab-tests with model product gas).

Presenter: **Thomas GOETZ, Wuppertal Institute, Wuppertal, GERMANY**

Presenter's biography:

Thomas Goetz is working as Project Coordinator in Division Energy, Transport and Climate Policy at the Wuppertal Institute for Climate, Environment and Energy, Germany

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Session reference: 2BO.2.5

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Valorization of Char from Biomass Gasification as Catalyst Support: Preliminary Results of Fischer-Tropsch Tests**

Short introductive summary:

This study investigates the feasibility of using char, a carbonaceous solid derived from biomass gasification, as catalyst support in Fischer-Tropsch reaction.

Since char from commercial biomass gasifiers exhibits remarkable properties very similar to the well-known carbonaceous materials (e.g. AC), it could replace them in many applications and cease to be treated as a waste that has to be disposed of.

For this reason, different Co-based catalysts supported on char and on a commercial AC selected as reference, were prepared through wetness impregnation and characterized through different techniques. Subsequently, the catalysts were tested in a fixed bed reactor under Fischer-Tropsch conditions.

According to the wide literature on carbon-supported catalysts for FT synthesis, the characterization results and the preliminary investigations of this study, there is the possibility to valorize char from biomass gasification as catalyst support.

Presenter: **Vittoria BENEDETTI, Free University of Bolzano, Faculty of Science and Technology, Bolzano-Bozen, ITALY**

Presenter's biography:

Vittoria Benedetti holds an MSc in Energy Engineering and currently is a PhD student in Sustainable Energy and Technologies at the Faculty of Science and Technology of the Free University of Bozen-Bolzano, Italy.

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Session reference: 3BO.3.1

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Lignin Depolymerization to Monophenolic Compounds in a Flow-Through System

Short introductive summary:

A reductive lignocellulose fractionation in a flow-through system in which pulping and transfer hydrogenolysis steps were separated in time and space has been developed. Without the hydrogenolysis step or addition of trapping agents to the process, it is possible to obtain depolymerized lignin (21 wt% monophenolic compounds) that is prone for further processing. By applying a catalytic transfer hydrogenolysis step the yield of lignin derived monophenolic compounds was increased up to 37 wt%. Pulp generated in the process was enzymatically hydrolyzed to glucose in 87 wt% yield without prior purification.

Presenter: **Maxim GALKIN, Stockholms Universitet, Organic Chemistry Dpt., Stockholm, SWEDEN**

Presenter's biography:

Postdoctoral fellow at Stockholm University (Organic Chemistry). Ph.D. in Organic Chemistry from Uppsala University (2015) Specialist degree in Chemistry (2004-2009) from Lomonosov Moscow State University.

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Session reference: 3BO.3.2

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

## Co-Production Schemes in the Bio-SNG Process: BTX Production and Harvesting

Short introductive summary:

Experimental Work performed with real gas produced from biomass gasification with the goal to convert ethylene into bio-aromatics (e.g. BTX) which can be more easily harvested from the gas. The goal is to improve the business case of Bio-SNG, with co-production of bio-aromatics

Presenter: **Carlos Filipe MOURÃO VILELA, ECN, Petten, THE NETHERLANDS**

Presenter's biography:

Since 5 years working at ECN in the field of Torrefaction and Biomass gasification. Before joining ECN, PhD at TU Eindhoven in the field of biomass gasification

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Session reference: 3BO.3.3

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Development of Cost Co-Processing of Bio-Oil and Crude Oil in a Conventional Refinery

Short introductive summary:

In this study various co-processing options were identified based on the bio-oil production process, upgrading method (if needed) and mixing point in a refinery (including the upgrading unit in bitumen processing). Therefore, a conceptual framework is developed to understand the feasibility and associated cost of co-processing bio-oil with conventional crude. The techno-economic assessment will be completed for the major pathways and feasibility of blending (in terms of bio-oil percentage), total capital and operational costs, and required hydrogen for upgrading (of bio-oil) will be presented. A rigorous simulation in Aspen HYSYS was developed to model co-processing of hydrodeoxygenated bio-oil (from pyrolysis) with VGO in an FCC reactor. There is a good agreement between the simulation and experimental data and it shows a promising method for production of fuels with renewable contents. The risks and benefits of co-processing for the refinery will be identified and examined by using sensitivity analysis.

Presenter: **Ali ALIZADEH, University of Alberta, Mechanical engineering department, Mechanical engineering department, edmonton, CANADA**

Presenter's biography:

M.Sc. student in Engineering Management program at the University of Alberta (Edmonton, Canada) with a background as a chemical process engineer in oil refining and petrochemical industry

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Session reference: 3BO.3.4

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## The Cost Drivers of Seaweed Based Fuel Production

Short introductive summary:

MacroFuels aims to produce sustainable biofuels from seaweed. In this presentation, we will present the technical achievements of converting seaweed to biofuels. Based on this reliable data, we have developed an economic model. With this model, we have identified the major cost drivers of two seaweed to biofuels pathways.

Presenter: **Jaap VAN HAL, TNO, ECN, Innovation Manager Biorefinery, Petten, THE NETHERLANDS**

Presenter's biography:

Jaap is the innovation manager biorefinery at ECN. Jaap got his M.Sc. from Leiden University and his Ph.D. from Rice in organometallic chemistry. He then worked for SABIC in Houston for about 10 year and moved in 2008 to ECN.

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Session reference: 3BO.3.5

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Towards a Sustainable Future - The Role of Biomass in Future Renewable-Based Energy Systems

Short introductive summary:

Denmark has set the ambitious target of achieving an energy system, which is independent of fossil fuels by 2050. Biomass can be converted to bioenergy which can be used for various purposes across several energy sectors. Therefore, given the ambitious Danish energy and climate policy agenda, bioenergy could potentially become the most significant energy carrier in future renewable-based energy systems. Thus, answers to the crucial question of the sectoral role of the limited biomass resource in future renewable-based energy systems are urgently demanded in the research field and by stakeholders and policymakers.

This project seeks to answer the emerging question and to contribute to the research field by developing energy system models, which can facilitate modelling of the integrated energy system including the power, district heating, gas, and transport systems. In this way, modelling the role of biomass in future effective, cost-efficient, and sustainable pathways towards future energy systems which achieve the energy policy targets can be facilitated.

Presenter: **Rasmus BRAMSTOFT, Technical University of Denmark, DTU Management Engineering, Kgs. Lyngby, DENMARK**

Presenter's biography:

Rasmus Bramstoft is a PhD student at the Technical University of Denmark. His field of research is modelling of integrated energy systems (power, heat, gas, and transport), where challenges related to cost-efficient and sustainable utilisation of the limited biomass resources are key topics. He currently participates in the Danish research project "FutureGas" focusing on the future role of gas, renewable gas, and the gas infrastructure in integrated, renewable-based energy systems. He has previously participated in a number of research projects involving integrated energy system analysis. Among these, Flex4RES which address challenges of integrating high shares of variable renewable energy in the energy system, the European progRESsHEAT which focuses on district heating/cooling in selected European countries, and Nordic Energy Technology Perspective 2016 where pathways for the transition towards a decarbonised Nordic energy system are presented.

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Session reference: 5BO.4.1

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

## Identifying the Optimal Use of Biomass within a Limited Resource Base: a Case Study of the UK

Short introductory summary:

Acknowledging the wide range of both biomass resource availability and technology costs, this work highlights advantages and trade-offs related to different low carbon energy pathways for the UK. It looks at the use of biomass in the wider context of the country's whole energy system and draws implications in terms of key technologies, ecosystem services, and best use of the different biomass feedstock.

Presenter: **Oliver BROAD, University College London, Institute for Sustainable Resources, London, UNITED KINGDOM**

Presenter's biography:

Oliver is a Researcher in Energy Systems Analysis and uses optimisation modelling frameworks to address relevant policy and investment questions around bioenergy in the UK. Previous work includes modelling and capacity building at national and regional levels in Southern Africa and Latin America.

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Session reference: 5BO.4.2

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS



**Intelligent Controlling of Power Driven Solid Biomass CHP Plants in Flexible District Heating with a Seasonal Heat Storage and a Power-To-Heat Component**

Short introductive summary:

The main work task is the simulation and optimization of an existing district heating system with a solid biomass CHP plant, by the intelligent integration of a power-to-heat component and a seasonal heat storage. For an efficient energy system, the flexible operation mode of the solid biomass CHP plant in order to be able to contribute in the energy is essential. In the focus of the simulation model is the optimized dimensioning and regulation of the different components in the energy system, in order to rise the resource efficiency (ecology, economy, efficiency) of the model. Concepts for a flexible heat supply with a high share of renewable energies will be developed and analysed in different scenario simulations. Based on the input data from the metering of the modelled heating grid and under the consideration of the energy prices, the program decides between different operation modes of the solid biomass CHP plant and determine the charging management of the seasonal heat storage.

Presenter: **Katharina KOCH, Technical University of Munich, Associate Professorship of Regenerative Energy Systems, Straubing, GERMANY**

Presenter's biography:

- 1999-2008 General qualification for university entrance(Maristen-Gymnasium Furth)
- 2008-2015 Study Electrical and Information Engineering (Bachelor und Master at the Technical University of Munich)
- Since 2016 Doctoral Candidate at the Associate Professorship of Regenerative Energy

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Session reference: 5BO.4.3

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

**Bioenergy Integration and Optimisation by Thermal Network Analysis "THENA"**

Short introductive summary:

Thermal networks allow the use of biomass to supply buildings and industry with thermal energy at high comfort and low pollution. The paper describes a design tool which enables a fast evaluation of the layout of a district heating system providing an assessment of the pipe dimensioning and a cost estimation. The application shows the effect of non-idealities such as over-dimensioning and too small temperature spreads in district heating. In addition, two concepts to optimise thermal networks are presented. On the one hand the implementation of thermal energy storage (TES) enables to ascertain a defined supply security with a reduced boiler capacity. A simulation based on measured data from DH networks reveal that a heat storage of 2 h to 3 h achieve a cost minimum for the climate in the Swiss midlands. On the other hand the shift of heat consumers to avoid demand peaks enables to increase the network capacity by more than 10 % enabling significant cost savings.

Presenter: **Thomas NUSSBAUMER, Verenum Research and Lucerne University of Applied Sciences, Zürich, SWITZERLAND**

Presenter's biography:

1984 Diploma as Mechanical and Process Engineer at the Swiss Federal Institute of Technology (ETH) Zurich  
1989 PhD on pollutant formation in biomass combustion at ETH  
since 89 Associate professor for Energy and Environment at ETH Founder & Head of Verenum Research for R&D in Bioenergy Swiss Delegate in IEA Bioenergy Task 32  
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Session reference: 5BO.4.4

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

## **Exergy Analysis of The Integration of Power-to-Gas Systems to Brazilian Sugarcane Biorefineries: Moving Towards Maximum Energy Conversion, Minimum Waste and Zero Co2 Emissions**

Short introductive summary:

Given the current scenario of sugarcane biorefineries in Brazil and the need for developing sustainable energy systems, the development of sugarcane plants connected to power-to-fuels systems is an opportunity to increase bioenergy production, reduce/neutralize CO<sub>2</sub> emissions and convert by-products into useful and added value fuels and chemicals.

Furthermore, in future energy systems with a high share of renewable energy is vital for solving the intermittency of inflexible energy sources. In this study, a power-to-gas system integrated to a 1G Brazilian sugarcane biorefinery was analysed based on exergy analysis.

Since the objective of this study is not only maximizing energy conversion in the sugarcane mills, but also reaching lower (or zero, if possible) CO<sub>2</sub> emissions, the CO<sub>2</sub>-rich streams were then considered to be used as feedstock to produce synthetic methane via power-to-gas (PtG).

Preliminary results show that the integration of PtG systems to 1G Brazilian sugarcane mills increases, in at least 3 times more, the conversion of the sugarcane carbon into final products (i.e., ethanol, electricity and synthetic natural gas).

Presenter: **PABLO SILVA ORTIZ, UNICAMP, CHEMICAL ENG., CAMPINAS, BRAZIL**

Presenter's biography:

Pablo Andrés Silva Ortiz has a BS in Energy Engineering from UNAB (2006) in Colombia. He also has an MS in Mechanical Engineering from UNIFEI (2011) and a Ph.D. in Mechanical Engineering at the USP in Brazil (2016). Research Areas of Interest: Exergy Analysis, Environmental Analysis, Biorefineries.

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Session reference: 5BO.4.5

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

## Developing a Biomass Gasification for Power Project in Italy: Lessons Learnt

Short introductive summary:

Contribution to the conference is the lessons learnt during the development of a biomass to power project. The project began as a research activity on an innovative gasification system and is becoming a commercial project of 400 KW electric power.

Goal of the project is to investigate the viability to use this technology for gasification for power without public subsidies.

Both technical and economic considerations will be presented from a point of view of a project developer which is also a researcher on the field.

Presenter: **Gian Claudio FAUSSONE, Inser Energia, Torino, ITALY**

Presenter's biography:

Graduated in industrial engineering he has been working in applied R&D projects for more than 10 years in Europe, California, Congo and Thailand on gasification, fuel synthesis, and waste-to-energy applications with leading institutions and private companies.

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Session reference: IBV.1.2

Subtopic: 6.2 Thermochemical conversion processes

Topic: 6. INDUSTRY SESSIONS

## **New Mobile, Slow Pyrolysis Technology Developed in Namibia Brings about Process Improvement, Optimisation and Efficient Biomass Conversion in the Charcoal Industry**

Short introductive summary:

Charcoal is the main product made from indigenous encroacher bush species and Namibia is the 5th largest barbeque charcoal producer globally. The charcoal industry gives more than 3,000 jobs in rural Namibia, and is therefore a main contributor to rural poverty mitigation in large parts of the country. However, the production is mainly based on inefficient conversion technology and processes which is cause for concern in terms of labour dissatisfaction, a high degree of unused by-products and unsustainable environmental practices. Research and development was conducted into improved charcoal production in Namibia in 2016/2017, which resulted in a more efficient mobile retort technology.

Presenter: **Dagmar HONSBEIN, iDeal-x integrated scientific services, Windhoek, NAMIBIA**

Presenter's biography:

I am a Namibian born, qualified wood scientist, with a post graduate degree in Chemical Engineering and Applied Sciences. I have spent some 20 years researching bush encroachment in Namibia and South Africa, with the particular interest in finding commercial use for the biomass obtained its harvest.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

Co-authors:

J Redecker, Redecker Retort Charcoal, Windhoek, NAMIBIA

Session reference: IBV.1.4

Subtopic: 6.2 Thermochemical conversion processes

Topic: 6. INDUSTRY SESSIONS

**Thermal Behaviour and Kinetic Analysis of Faecal Biomass and Blends**

Short introductive summary:

Resource recovery and utilisation are essential sustainable development solutions, particularly for solid waste streams (sewage sludge, industrial waste etc). For decentralised sanitary solutions, fresh human faeces are considered a global bioenergy resource because of their energy potential and the opportunities it presents to reduce waste quantities and emissions — prospects that require energy conversion and recovery processes. Thermo-chemical conversion can enable the release of the chemical energy in faecal materials to other energy forms, either in the presence or absence of oxygen. Its application in sanitary technologies however, require a fundamental understanding of how human faeces (dry and as received basis) behave when subjected to heat and controlled temperature changes.

Presenter: **Tosin ONABANJO SOMORIN, Cranfield University, Energy & Power, Bedford, UNITED KINGDOM**

Presenter's biography:

Tosin is actively contributing to the development of the Nano-Membrane Toilet, a project funded by the Bill and Melinda Gates Foundation and designed for people lacking access to modern sanitation.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: IBV.1.5

Subtopic: 6.2 Thermochemical conversion processes

Topic: 6. INDUSTRY SESSIONS

## **Waste-To-Fuel Technology in Albania - How to Implement a Renewable Energy System in Europe's Largest Onshore Oilfield**

Short introductive summary:

Albania has historically been known to have an active but challenging drilling activity that demands the most innovative technology to develop, predominantly, medium-heavy oil reservoirs. Many developed countries diversify their energy production in order to avoid strict dependency on crude oil. An emblematic and modern option that is extensively gaining popularity in Europe focuses on renewable energy from sophisticated recycling programs. Furthermore, two crucial reasons that should motivate Albania to investigate new applications for energy recycling are (1) alternatives to crude oil and petroleum products that can be supplemental and provide stable access to fossil fuels (2) industrial and municipal recycling via waste management to reprocess waste and produce industrial raw material - spawning the emergence of a "circular economy" to develop the backbone needed to strengthen the industrial and manufacturing markets for a self-sustaining economy.

Presenter: **Besmir BURANAJ HOXHA, Petro Fluids LLC, none, Houston, USA**

Presenter's biography:

Besmir is a Sr. Research Scientist at the University of Texas at Austin that specializes in Drilling Fluids, Fluids Automation, and Rock Mechanics. He holds a degree in Chemistry/Engineering and a Masters in Operations Research. Additionally, he is a Sr. Technical Adviser at Petro Fluids.

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Session reference: IBV.1.6

Subtopic: 6.2 Thermochemical conversion processes

Topic: 6. INDUSTRY SESSIONS

## Micro-Scale Chp Technologies - State of the Art

Short introductive summary:

Since almost two decades small-scale biomass heating system manufacturers aim at developing micro-scale CHP technologies. Reaching from simply self-supply with electricity to power supply to the grid the potential applications are very promising. Recent developments of our energy system strongly support the ideas: several renewable sources of electricity show quite high variability, both seasonal and short-time, and therefore call for power generation technologies being able to balance these fluctuations. Especially for the seasonal variability, resulting in significant lower renewable electricity supply in winter (mainly coming from lower PV and Hydropower), electricity cogeneration of biomass heating systems seems to be a perfect solution.

This study highlights the technology advances of the past 5 years and provides performance as well as economic data for available technologies. Finally an outlook on future developments of different micro-CHP technologies is given.

Presenter: **Christoph SCHMIDL, Bioenergy 2020+, Biomass Combustion Dpt., Wieselburg-Land, AUSTRIA**

Presenter's biography:

PhD in Technical Chemistry at Vienna University of Technology on Gaseous and Particulate Emissions from Biomass Combustion. Since 2009 Senior Researcher at the research centre Bioenergy2020+. Since 2013 head of master program "renewable energy" at University of applied sciences Wr. Neustadt.

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Session reference: IBV.1.7

Subtopic: 6.3 Power & Heat processes and systems

Topic: 6. INDUSTRY SESSIONS



## **CFB Technology Advantages in Solid Biomass Fuel Firing**

Short introductive summary:

One alternative to respond to the challenges of global warming by reducing greenhouse gas emissions is biomass combustion. Increasing boiler efficiency and the use of biomass and other solid renewable fuels are well in line with global CO<sub>2</sub> reduction objectives. Circulating Fluidized Bed boilers (CFB) are ideal for efficient power generation, capable to fire a broad variety of solid biomass fuels from small CHP plants to large utility power plants. Biomass boilers are also capable of co-firing with multiple fuels, including agro-biomass, RDF and coal.

Presenter: **Kalle NUORTIMO, Sumitomo SHI FW, VARKAUS, FINLAND**

Presenter's biography:

Kalle Nuortimo has been working in Sumitomo SHI FW since 2002 in technology, R&D, marketing and communications related positions. The current position in Sumitomo SHI FW Energia Oy Finland is Market Analyst. Sumitomo SHI FW Energia Oy in Finland is the center of excellence for the CFB technology.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: **IBV.1.8**

Subtopic: **6.3 Power & Heat processes and systems**

Topic: **6. INDUSTRY SESSIONS**

**Combustion System for Gaseous and Liquid Biofuels with Low Pollutant Emissions**

Short introductive summary:

Within a German national research project (AiF, IGF 18188 N), Gas- und Wärme-Institut Essen e.V. and Oel-Waerme-Institut gGmbH are developing a bio-fuel combustion system for industrial applications. In this contribution, we present the industrial scale-up to 300 kW thermal power of the developed combustion system. The system consist of a fuel evaporator and a non-premixed swirl burner for the combined use of different types of gaseous and liquid biofuels. Bio-oils were evaporated in a loop reactor, which can be operated self-sustaining without the supply of extra energy after the starting process. The reactor is heated by exothermal reactions of the evaporated fuel. The design of the non-premixed swirl burner bases on the COSTAIR concept, which ensures a continuously staged air feeding into the combustion zone. We present experimental results for the combustion of different bio-oils at a thermal power of 300 kW in a test furnace. Global equivalence ratios were varied in the range of 0.7 - 1.1. Temperature and concentrations of combustion products were measured in the exhaust duct. The preliminary results show a low NOx and CO emission level and a stable combustion behavior.

Presenter: **Jörg LEICHER, Gas- und Wärme-Institut Essen e.V., Industrial Combustion Technology, Essen, GERMANY**

Presenter's biography:

Research Engineer at GWI since 2009

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Session reference: IBV.1.9

Subtopic: 6.3 Power & Heat processes and systems

Topic: 6. INDUSTRY SESSIONS

## The Dall Energy Biomass Furnace

Short introductive summary:

Three dall energy biomass furnaces (two in Denmark and one in USA) have been built.

All three are in commercial & unmanned operation.

Several unique features has been documented in the 3 plants:

- Great fuel flexibility (Garden Waste, Manure, Spent grain, 20-60% water content)
- High turn down ration 1:10
- CO below 5 mg/Nm<sup>3</sup> even at 10% load
- Dust out of furnace below 50 mg/Nm<sup>3</sup>
- No Cyclone, Bagfilter or Electrostatic filter nessesary.
- NO<sub>x</sub> : 175 mg/Nm<sup>3</sup>

Presenter: **Jens Dall BENTZEN, Dall Energy, R&D, Hørsholm, DENMARK**

Presenter's biography:

Mr. Bentzen graduated in 1995 with a MSC in thermal gasification of biomass

In 2007 Dall Energy was founded.

Focus was put on the development and verification of the Dall Energy biomass furnace, which offers:

- Fuel flexibility
- High Turn down ratio : 10-100%
- Low emissions: Dust, NO<sub>x</sub> and CO.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

Co-authors:

JDB Bentzen, Dall Energy, Hørsholm, DENMARK

Session reference: IBV.1.10

Subtopic: 6.3 Power & Heat processes and systems

Topic: 6. INDUSTRY SESSIONS

**Combustion of Horse Manure Pellets: Performance and Emissions**

Short introductive summary:

The goal of this study was to ensure that horse manure pellets fulfill the ISO 17225 quality standards and as well as the emission limits of Swiss Air Pollution Control. Different mixtures of horse manure, cereal waste and mycotoxin-grain were pelletized utilizing the patent-ed Bioburn-process. Analysis showed that compared to wood pellets, horse manure pellets have very good mechanical properties, similar water content, heating value and bulk density and thus, similar combustion behavior. The massively higher ash, potassium, nitrogen and chlorine contents are critical regarding dust and NOX-emissions, slagging and the formation of polychlorinated dibenzodioxins and furans (PCDD/F). A suitable combustion test system was found with the 550 kW grate furnace of Schmid energy solutions. During combustion tests a high level of contaminants were found in concentrated form in the different ashes. Measurements also confirmed the established correlation between PCDD/F content in the flue ash and the flue gas (over four powers of ten) as well as correlation between PCDD/F content in the flue gas and the chlorine content in the fuel.

Presenter: **Timothy GRIFFIN, University of Applied Sciences, Northwestern Switzerland, Institute of Biomass and Resource Efficiency, Windisch, SWITZERLAND**

Presenter's biography:

Bachelor, Master and PhD degrees in chemical engineering. 15 years of experience at ABB and Alstom corporate research centers. Since 2005 professor of thermal energy technology at University of Applied Sciences, Northwestern Switzerland.

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Session reference: IBV.1.11

Subtopic: 6.3 Power & Heat processes and systems

Topic: 6. INDUSTRY SESSIONS

**Energy Recovery from Pig Farm and Slaughter House Organic Wastes**

Short introductive summary:

One of the main environmental problems of today's society is the continuously increasing production of organic waste. Food production is achieved with significant energy consumption and waste generation on relatively large quantities. The high content of organic constituents found in this type of waste, rendering those to be suitable for regenerative bio-energy process. New European regulations on wastewater sludge management will be based on bio-solids disposal methods, including application for the agricultural land.

Under the frame work of "Waste to Energy" the related study from present article focus on the energy efficiency of an industrial food provider due to energy recovery from their own waste produce, which can increase the economical savings for industrial food stakeholders.

The methodology approached is to highlight the bio-methane potential of the available organic wastes as co-substrates in order to establish a suitable mixture for digestate, and the possibilities to convert the existing pig slurry storage tanks into anaerobic digester, aiming to reduce the investment of energy recovery plant.

Presenter: **Ioana IONEL, Universitatea Politehnica Timisoara, Mechanical Engineering Dpt., Timisoara, ROMANIA**

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Session reference: IBV.1.14

Subtopic: 6.4 Biochemical Conversion

Topic: 6. INDUSTRY SESSIONS

## The Role of Oxygen Concentration Analysis in the Production of Biofuels

Short introductive summary:

The comparatively high oxygen levels of organic feedstocks for biofuel production can lead to potentially harmful corrosion in biorefineries. Generation of “free water” from various oxygenates contained in the biofuel can result in higher corrosiveness of the raffinates processed in a biofuel refining facility. Monitoring of the raffinate oxygen levels can therefore be used to track down potential corrosion threats.

Presenter: **René NOWKA, Elementar Analysensysteme GmbH, Langenselbold, GERMANY**

Presenter's biography:

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Session reference: IBV.1.15

Subtopic: 6.4 Biochemical Conversion

Topic: 6. INDUSTRY SESSIONS

**Conversion of Mixed Organic Residue Feedstocks to Drop-In Hydrocarbon Fuels via the IH2® Technology - Process Development Trajectory**

Short introductive summary:

The attached abstract describes the technology development trajectory and recent progress associated with the IH2(R) process. This process represents a unique approach to biomass conversion, and allows biomass and biomass-derived materials to be converted to fully-deoxygenated liquid hydrocarbon fuels in two simple stages. It avoids the complications associated with pyrolysis and upgrading of pyrolysis oils, and does not involve gasification. The chemistry associated with the process involves devolatilization of feedstock and hydrodeoxygenation and is self-sufficient with respect to hydrogen. The process has been licensed and commercialized by CRI, a subsidiary of Shell. A demonstration-scale plant, capable of converting five tons per day of feedstock, has now been commissioned. The presentation associated with the attached abstract will describe the technology development trajectory of this process, and will provide recent information on work carried out at the demonstration scale.

**Presenter: Dhairya MEHTA, Shell Technology Centre Bangalore, Novel Catalytic Materials, Bangalore, INDIA**

Presenter's biography:

Dhairya is a Process Researcher at Shell Technology Centre Bangalore. He is currently the activity lead for R&D of IH2® process, an advanced drop-in biofuels technology. He has a PhD in Chemical Engineering from Purdue University and a B.S. Chemical Engineering from Institute of Chemical Technology.

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Session reference: IBV.1.20

Subtopic: 6.4 Biochemical Conversion

Topic: 6. INDUSTRY SESSIONS

## **Recovery of Phosphate after Hydrolysis and Material Utilization of Organic Waste**

Short introductive summary:

This contribution considers the recovery of phosphate from fermentation broth after hydrolysis and material utilization of organic waste. Phosphate in organic wastes is due to low quantities and strong dilution after fermentation ignored. The proposed methods considers the adsorption of phosphate on powderer mussel shells. This approach can basically be integrated in many fermentation processes where amounts of phosphate-containing broths are appearing.

Presenter: **Jan Christoph PEINEMANN, Leuphana University, Lüneburg, GERMANY**

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Session reference: 3BV.2.1

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Chiral Pesticides from Biomass Feedstocks

Short introductive summary:

As the chemical structures of new pesticides become larger or more complex with multiple chirality to control new diseases, pests and weed species efficiently, and to meet more favorable environmental and toxicological requirements, natural products and their derivatives will have to drive the development of the new pesticides. However, economic synthesis routes and technologies are currently limited for developing new chiral pesticides from biomass feedstocks. Biorefinery technologies utilizing biomass feedstocks instead of petroleum have now become a subject of interest worldwide and various technologies have been available for producing bio-platform chemicals. Thus, chiral compounds from biomass feedstocks could be used for producing enantiomerically pure pesticides. Chiral building blocks and their derivatives could be used to various ways during the development of new chiral pesticides and the biorefinery technology will accelerate the development. The use of chiral synthons derived from biomass feedstocks could also be expected to reduce carbon dioxide to cope with climate change.

Presenter: **In Taek HWANG, Korea Research Institute of Chemical Technology, Carbon Resources Institute, Daejeon, REPUBLIC OF KOREA**

Presenter's biography:

In Taek Hwang received his BE, MS and PhD degrees in 1981, 1986 and 1996, respectively in applied biology and chemistry from Chonbuk National University. He has been a principal research scientist at KRICT since 2000. His current research work is focused on bioconservation in the biorefinery process, especially, discovery of a new enzymes and genes from various organisms applicable in biomass utilization including biocatalysis.

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Session reference: 3BV.2.2

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Nitrogen Recovery from Liquid Effluents by Activated Biochar from TCR® Process for the Production of Bio-Fertilizers**

Short introductive summary:

The development of a bio-fertilizer is focussed to apply nutrients on demand on the field. This material must be storable, easy to transport and shall release nutrients for the plants but not to the surface or groundwater. The char produced from biogenic residues by Thermo-catalytic Reforming (TCR®) is a suitable raw material. It is very low in hydrogen and oxygen content and therefore very stable in soil. Furthermore, it is free of organic pollutants and the surface area can be increased comparable to conventional activated carbon. With a modified surface area nitrogen can be adsorbed from liquid streams like digestate and manure. Additionally, it is an option to get the drinking water nitrate free.

Presenter: **Fabian STENZEL, Fraunhofer-Institut UMSICHT, Biological Process Technology, Sulzbach-Rosenberg, GERMANY**

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Session reference: 3BV.2.3

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Performance Analysis of Biomass Based Ammonia Production from Integrated Gasification

Short introductive summary:

The biomass gasification process integrated with the sorption enhanced water gas shift reactor using magnesium oxide as an absorbent is applied to produce suitable hydrogen and nitrogen ratio and enhance the performance of bio-ammonia production process.

Presenter: **Amornchai ARPORNWICHANOP, Chulalongkorn University, Chemical Engineering Dpt., Bangkok, THAILAND**

Presenter's biography:

Amornchai Arpornwichanop received B.Eng. and D.Eng. degrees in chemical engineering from Chulalongkorn University (Thailand) in 1997 and 2003, respectively. Since 2003, he has been with the department of chemical engineering, faculty of engineering, Chulalongkorn University.

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Session reference: 3BV.2.5

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Bioenergy and other High-Value Products to Enhance Soil Fertility and Mitigate Climate Change: the Wood-Up Project on Woody Biomass Gasification in South-Tyrol**

Short introductive summary:

In South Tyrol, a region in the North of Italy, around 580,000 m<sup>3</sup> of woody biomass are annually used in more than 70 district heating plants, which altogether produce 724 GWh of heat and 57 GWh of electricity. During the last years, more than 40 small-scale gasification plants were installed, implementing 13 different gasification technologies, producing about 7 MW of electrical power and 9 MW of heat. The WOOD-UP project was developed with the main aim of assessing the characteristics of the gasification char and its effects on soil fertility and, at the same time, evaluating the effects of the biochar application on the quality of the agricultural products and the GHG emissions from the field. In this work, the preliminary results are shown.

Presenter: **Daniele BASSO, Free University of Bolzano, Faculty of Science and Technology, Bolzano, ITALY**

Presenter's biography:

Post-doctoral researcher at the Free University of Bolzano. Topics: thermochemical conversion processes (pyrolysis, gasification, hydrothermal treatments).

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Session reference: 3BV.2.6

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## From By-Product to Valuable Resource - Process CO<sub>2</sub> for Present and Future Utilization to Chemicals

Short introductive summary:

The energy and economy market is in transformation from fossil based towards sustainable and renewable based. Within this transformation the bioeconomy is a steady growing field with already today remarkable progress and achievements. Thereby, the foundation of the bioeconomy is the added value by relying on biomass as sustainable and renewable substrate for various aspects. This includes energy, fuels and with a raising share materials (e.g. chemicals and fibers).

One so far underrepresented aspect is the utilization of chemicals from CO<sub>2</sub> as by-product e.g. from biomass conversion processes like anaerobic digestion.

Presenter: **Eric BILLIG, Umweltforschungszentrum UFZ, Bioenergie Dpt., Leipzig, GERMANY**

Presenter's biography:

Eric Billig studied environmental engineering in Berlin. He first started to work at the KIT in Karlsruhe and was responsible for experiments based on the pyrolysis of biomass. Shortly after that he changed to the DBFZ (German Biomass Research Center) in Leipzig, where he works since 2010 as research associate. Since 2012 he is dedicated to his PhD thesis which deals with the evaluation of biomethane and bio-SNG production plants.

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Session reference: 3BV.2.7

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Excess Volume of Mixing in Blends of Furan-Type Biofuel (2- Methylfuran) + Alcohols**

Short introductive summary:

Some limitations of biofuels as a direct substitute for petrol have inspired the production of 2-methylfuran, a promising furan-type biofuel from biomass. When alcohols are mixed with 2-methylfuran, mixing properties with varying intermolecular interactions may be generated. To investigate this effect, the densities and excess molar volumes for binary mixtures of MF with 1-propanol/2-propanol/1-butanol/2-butanol/2-pentanol/1-hexanol have been studied over the entire range of composition at 298.15 K and atmospheric pressure.

Presenter: **Luis FOLLEGATTI, USP, Chemical Engineering, São Paulo, BRAZIL**

Presenter's biography:

Prof. Follegatti was born in 1981 in Lima, PERÚ. He studied Thermodynamics and fuels Technology at UNICAMP-BRAZIL. He has been working at the University of São Paulo since 2015 where he created a research group that had its initial impulse through a financial support from FAPESP foundation.

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Session reference: 3BV.2.10

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Valorization of Light Oxygenates in Bio-Oil via Catalytic Tandem Reaction Involving C-C Bond Formation**

Short introductive summary:

Bio-oil produced from non-edible plants, is a promising feedstock towards sustainable transport fuel production via FCC unit in existing refinery. However, bio-oil is corrosive to engine parts because it has low pH (2.5) due to its higher acidity originating from carboxylic acids, e.g. acetic acid. It is also unstable, phase separate with time owing to its higher water and oxygen content, and thus lower energy density (20 MJ/kg) equivalent to half of conventional heavy fuel. The above demerits of bio-oil thus necessitates upgrading to improve its suitability as a feedstock to existing refinery configuration or as a direct drop-in transport fuel. Bio-oil is a potential feedstock to facilitate the transition from fossil to Biomass fuel economy if smaller carbon fractions (C2-C4) in the bio-oil is fully utilized. The higher reactivity of these multiple oxygen functionality in bio-oil could be positively utilized to achieve C-C bond formation reactions such as esterification, ketonization and aldol condensation via intramolecular oxygen removal as CO<sub>2</sub> and H<sub>2</sub>O. Thereby increasing the carbon density of light oxygenates to fuel range (C6+).

Presenter: **Kumar ROUT, Trondheim, NORWAY**

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Session reference: 3BV.2.13

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

**Simulations and Thermodynamics for Recovery of Liquid Biofuels from Syngas Fermentation Processes**

Short introductive summary:

Syngas fermentation is an indirect conversion process for the production of alcohols, organic acids and other chemicals; it is referred to as an indirect fermentation because the feedstocks are not directly fed in the bioreactor to form products, but are first gasified into syngas. Compared with traditional fermentations, syngas fermentation has lower reported production concentration; therefore more energy is required for the downstream product recovery from the aqueous fermentation phase. A benchmarking study for different ethanol and acetic acid recovery methods from diluted aqueous solution has been performed. Among the cases considered are: traditional atmospheric distillation, mechanical vapor recompression, multi-effect distillation, azeotropic distillation and hybrid extraction/distillation.

Presenter: **Mauro TORLI, Technical University of Denmark, Department of Chemical and Biochemical Engineering, Lyngby, DENMARK**

Presenter's biography:

Mauro Torli is a PhD student at the CERE, Technical University of Denmark. He graduated in industrial chemistry at the University of Milan with a dissertation on bioethanol steam reforming and PEM-FC cogeneration. His current work focuses on biofuel production and product recovery.

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Session reference: 3BV.2.14

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Metal Impregnated Biochar for the Removal and Controlled Release of Phosphorus

Short introductive summary:

Utilization of organic waste as a renewable energy source is promising for sustainability and mitigation of climate change. Pyrolysis can produce gas, oil and char from organic waste. Phosphorus (P) is an irreplaceable essential element for all living organisms and economical mining of its resource (phosphate rock) is estimated about 100 years. Therefore, P recovery from waste and wastewater is a critical issue for sustainable society. In this study, coffee waste is thermally treated to produce biochar and it was impregnated with Mg/Fe to enhance phosphates adsorption and P bioavailability. Kinetics of phosphates adsorption/desorption and bioavailability analysis were carried out to estimate its potential as a P removal adsorbent and a fertilizer.

**Presenter:** Dong-Jin KIM, Hallym University, Department of Environmental Sciences and Biotechnology, Chuncheon, REPUBLIC OF KOREA

Presenter's biography:

PhD from KAIST in Chemical Engineering 1990

Postdoctoral Fellow at Caltech, 1990-1992

Process Engineer at SK Engineering & Construction Ltd 1993-1997

Professor of Environmental Science and Biotechnology and Director of Institute of Energy and Environment from 1997 to present.

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Session reference: 3BV.2.19

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Life Cycle Assessment of Bioenergy Systems: Lessons Learned in a Heated Decade

Short introductive summary:

Life Cycle Assessment (LCA) is a key tool for sustainable production and consumption targets and it is increasingly integrated into the policymaking process.

The interpretation phase is crucial to make sure that the results are consistent with the defined goal and scope and that the conclusions presented are robust. However, too often practitioners have overlooked this fundamental phase of the LCA and have drawn conclusions which are either not supported by the study performed or that go well-beyond what the limitations of the study would allow.

Bioenergy is an emblematic case of misinterpretation of LCA results and of miscommunication between LCA practitioners and decision-makers. This has actually led to the implementation of policies which have then required serious amendments with broad-ranging consequences on the stakeholders affected.

In the last decade, the LCA community working on bioenergy has made significant progresses in better understanding the implications of bioenergy systems on the economy, the climate and on ecosystems.

This work summarizes the lessons learned by the LCA community dealing with bioenergy and biofuels in the last decade.

Presenter: **Jacopo GIUNTOLI, European Commission, JRC, Italy - International Council on Clean Transportation, Washington, DC, Ispra, USA**

Presenter's biography:

Jacopo Giuntoli has a PhD in Energy Engineering, member of the Sustainable Transport Unit in the JRC (European Commission) since 2010. He is part of a team providing scientific and technical support to policymakers on bioenergy environmental sustainability.

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Session reference: BP.1.1

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Assessing and Mitigating ILUC Impacts of 2g Biofuel Technologies at Project Level

Short introductive summary:

The aim of this study is to explore the challenges and opportunities of assessing potential ILUC impacts of 2G biofuel technologies at project level. We evaluate two projects for commercial scale production of cellulosic ethanol in Europe (Italy and Slovakia). We analyse each project's feedstock supply chains as proposed by the investors including dedicated energy crops on marginal land; agricultural residues; and woody biomass. For the analysis we apply the Ecofys (2013) "Credible Robust Certification of Low ILUC biofuels" and a Causal Descriptive Methodology (CDM) we developed for this study. Our methodology employs GIS techniques, analysis of historic trends and market data and expert consultation to identify and quantify the potential ILUC impacts of individual projects. The results provide insights on (i) the potential ILUC impact of the biofuel projects studied; (ii) the challenges of assessing impacts at project level employing the two methodologies; (iii) the opportunities to use knowledge of potential ILUC to develop mitigation strategies at project level; and (iv) need for post-2020 regulations to ensure that the risk of ILUC is effectively accounted for at project

Presenter: **Lorenzo DI LUCIA, Imperial College, Centre for environmental policy, London, UNITED KINGDOM**

Presenter's biography:

Dr Di Lucia works on the development of a landscape approach to the governance of land use and bioenergy systems by coupling quantitative modelling and stakeholder engagement. The approach seeks to facilitate the planning of biofuel projects that promote ecosystem services and human well-being

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: BP.1.4

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

**Best Available Technologies to Harvest Cereal Chaff**

Short introductive summary:

Cereal chaff, compound by glumes and husk covering the seeds, is a valuable resource not usually collected. Normally, after threshing, it is left on the ground together with other thinner part of the cereal stem and a certain amount of weed seeds. Since its value as substrate for animal feed or litter, or as feedstock in biogas plants and biomass boilers, many machineries builders has recently developed several systems for its recovery.

The study represents a detailed and accurate survey of the harvesting technologies available at present in the European market.

Presenter: **Vincenzo ALFANO, CREA - Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Monterotondo (Rome), ITALY**

Presenter's biography:

Dr. Vincenzo Alfano has got more than 10 years of research experience in the field of bioenergy. Currently he works at CREA – Consiglio per la ricerca in agricoltura e l'analisi dell'economia. Previously he has worked at ENEA achieving a huge experience in the biomass availability assessment.

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Session reference: 1BO.5.1

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Energy Recovery Alternatives of the Olive Oil Industry Byproducts

Short introductive summary:

Waste-to-energy is the process of producing heat and power from the primary treatment of waste. For the case of the olive oil industry residues, this process kills two birds with one stone as it is considered to be a sustainable waste management approach, providing at the same time a renewable energy resource.

This study aims to present the state-of-the-art in the field of energy recovery alternatives of the residues and the by-products of the olive oil industry. The current practices in analysing the elemental and proximal value of wet and exhausted olive pomace is discussed, and concrete results of analysis of different olive oil solid and liquid residues are presented. Mechanical techniques to upgrade the solid olive kernel, in order to be pelletized and torrefied are presented and discussed. The environmental concerns regarding the entire supply chain are addressed as well in this study, by means of the presentation of state-of-the-art studies in the field of life cycle assessment of olive kernel. The main thermochemical conversion routes are presented and discussed.

Presenter: **Paris A. FOKAIDES, Frederick University, Sustainable Energy Research Group, Nicosia, CYPRUS**

Presenter's biography:

Dr. Fokaides is the academic supervisor of the Sustainable Energy Research Group in Frederick University, Cyprus. His research is primarily concerned with the elemental and proximal analysis of biomass sources, as well with biomass thermochemical conversion technologies (pyrolysis).

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Session reference: 1BO.5.2

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

**Effect of Harvest Time on the Composition of Tall Wheatgrass Biomass Under Mediterranean Conditions**

Short introductive summary:

Cool season grasses, drought-resistant perennials, are being considered nowadays as energy crops for solid biomass production in the European Mediterranean region, particularly for marginal lands where traditional crops are not economically viable. However, summer harvested cool season grasses, the traditional harvest time, are prone to cause sintering, corrosion and emission problems during the combustion of this biomass due to their high levels of troublesome elements, in particular chlorine and alkaline metals. This work shows how harvest time affects biomass production and the composition of the biomass obtained from three cultivars of tall wheatgrass (var. Alkar, Bamar, and Szarvasi-1).

Presenter: **Ruth BARRO, CIEMAT, Biomass Unit - Dpt. of Energy, Lubia (Soria), SPAIN**

Presenter's biography:

Researcher at CIEMAT

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Session reference: 1BO.5.3

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## **Impact of Sampling and Measurement System on the Feedstock Receiving Capacity of A Biomass Power Plant**

Short introductive summary:

This study analyzes three different sampling and measurements methods and focuses how these impact on receiving facility capacity. Analyze is carried by an agent-based simulation model of chip reception. This model includes chips logistics from power plants gate to the intake of the boiler. Compared runs of the simulation are made and analyzed to evaluate the performance of different sampling and measurement systems.

Presenter: **Mika AALTO, Lappeenranta University of Technology, Laboratory of Bioenergy, Mikkeli, FINLAND**

Presenter's biography:

Junior researcher from Lappeenranta University of Technology, Finland. Specialised in agent-based modelling and numerical methods in biofuel quality modelling. Recently have been working on agent-based simulation models of biomass logistic systems.

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Session reference: 1BO.5.4

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **Biomass for Farming Use from Orchard Pruning and Src in Sicily**

Short introductive summary:

A Sicilian horticultural and nursery farm produces vegetables in greenhouses by self-production of energy using wood chip boiler. Winter heating of greenhouses of about 4500 cubic meters biomass requires at least 60% of residues of pruning and the rest from SRC grown on the farm. The study assesses the economic and environmental sustainability in the cultivation, management and supply of these biomasses.

Presenter: **Gianni FACCIOTTO, CREA- Council for Agricultural Research & Economics, Foreste e Legno, Casale Monferrato, ITALY**

Presenter's biography:

Gianni Facciotto, since 1981 he has been working as a researcher for the former Poplar Research Institute, now Forestry and Wood Research Center of Council for agricultural research and economics (CREA), in Casale Monferrato (Italy).

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Session reference: 1BO.5.5

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES



## **Compared Analysis of Sulfur, Nitrogen and Heavy Metal Compounds of Solid Recovered Fuels Air Gasification at Pilot Scale**

Short introductive summary:

Solid Recovered Fuel are waste based fuel, and can be use in gasification processes to be converted into synthetic gas. The raw gas, containing pollutants, has to be cleaned to be used in engine or turbine to produce heat and electricity. Compared to raw wood, waste based fuels contain additives and pollutants precursors that may impact syngas quality. This work compares sulfur, nitrogen and heavy metal compounds released during air gasification of four differents SRF and one raw wood.

Presenter: **Gwendal VONK, Cirad, BioWooEB, Montpellier, FRANCE**

Presenter's biography:

3rd year PhD student, employee of the company Enerxyl. I work in the research unit BioWooEB - Cirad, in France. The subject of my PhD is the characterization of Solid Recovered Fuel gasification in downdraft fixed bed reactors at pilot and industrial scale

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Session reference: 2BO.6.1

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Influence of Phosphorous and its Fate during Thermo-Chemical Conversion of Biomass in a Fluidised Bed**

Short introductive summary:

The influence of phosphorous on fluidised bed biomass thermo-chemical conversion was studied in this work. Therefore, several experiments were conducted in a bench-scale fluidised bed with different fuels with varying phosphorous contents. The resulting fractions (i.e. ash, bed material) were studied according to their composition.

Presenter: **Matthias KUBA, Bioenergy 2020+, Graz, AUSTRIA**

Presenter's biography:

Matthias KUBA has studied chemical engineering at TU Wien, Austria. He is currently working as unit head and senior researcher at Bioenergy2020+ GmbH in the field of fluidized bed gasification. In addition, he closely collaborates as post-doctoral research fellow with Umea University and Lulea University of Technology, Sweden.

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Session reference: 2BO.6.2

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Adsorption of H<sub>2</sub>S on Residual Biomass Gasification Char**

Short introductive summary:

H<sub>2</sub>S is a common pollutant of biomass derived gaseous fuels, and it can be easily removed by adsorption. Residual char from biomass gasification is a porous carbon rich material, already proved to be suitable for the adsorption of CO<sub>2</sub>. In this work, it was employed for the adsorption of H<sub>2</sub>S. Several samples of char from commercial gasification plants were collected and characterised, and adsorption experiments were performed in a fixed bed with continuous analysis of the outflow gas composition, in order to obtain the breakthrough curves. The suitability of biomass gasification char for this process was assessed, and thus another basis for the valorisation of this residue was posed.

Presenter: **Filippo MARCHELLI, Free University of Bolzano, Faculty of Sciences and Technology, Bolzano, ITALY**

Presenter's biography:

I am a chemical engineer from Genova, currently studying for my PhD in Sustainable Energies and Technologies at the Free University of Bolzano. My research interests include biomass valorisation and process simulation.

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Session reference: 2BO.6.3

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Glycerol Low Temperature Steam Reforming for Bio-SNG**

Short introductive summary:

The submission includes a summary and explanatory pages of my work on steam reforming of glycerol for bio-synthetic natural gas.

Presenter: **Robert WHITE, University of Leeds, Leeds, UNITED KINGDOM**

Presenter's biography:

I am in my final year of my PhD project. Prior to this I completed an MChem at the University of Leicester. My PhD project consists of chemical engineering, economic and life cycle energy aspects.

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Session reference: 2BO.6.4

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **A Modelling Based Study on the Integration of Indirect Biomass Gasification, Methanol and Power Production**

Short introductive summary:

The focus of this study is on indirect gasification of 10MW biomass input and its integration with methanol synthesis and power production processes. For this purpose, a model was developed in Aspen Plus in order to study the effect of choosing different technologies (Absorption Enhanced Reforming, Integrated Gasification Combined Cycle system, Inverted Brayton Cycle (IBC) gas turbine) and parameters within the blocks on the overall process behaviour. This model accurately predicted the composition of the major product gas from the gasifier and the operational conditions of all the identified blocks within the methanol synthesis process. Furthermore, it can serve as a generic tool for the comparison of the effect of different choices in technology on the performance of the overall methanol synthesis process.

Presenter: **Balaji SRIDHARAN, Technical University of Delft, Process and Energy Laboratory, Eindhoven, THE NETHERLANDS**

Presenter's biography:

Master of Science in Mechanical Engineering specializing in Process and Energy. Passionate about research in Biomass and renewable energy.

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Session reference: 2BO.6.5

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Natural Deep Eutectic Solvents (DES) for Fractionation of Waste Lignocellulosic Biomass and its Cascade Conversion to Value-Added Bio-Based Chemicals**

Short introductive summary:

To reduce the dependence on fossil fuels for everyday requirements, it has become inevitable to find alternate sources for energy and other requirements. In order to meet the future demand for raw materials and fine chemicals a renewable resource is required. Researchers have been working to utilize bio resources mainly plant based to produce fuel and value added chemicals. To produce fine chemicals from lignocellulosic biomass, its components has to be fractionated into cellulose, hemicellulose and lignin, these can then be converted to fine chemicals via hydrolysis, hydrogenation, oxidation, oxidative cracking, hydro deoxygenation or depolymerisation.

Fractionation of lignocellulosic biomass into its constituents is the first step in a bio refinery for pre-treatment to separate cellulose and lignin. This can be achieved by thermal or chemical treatments like steam explosion, wet oxidation, acidic or basic treatment, organosolv process and ionic liquids. Though there are some advantages, these methods have the disadvantage of costly and corrosive solvents, high temperature and pressure, high equipment costs and solvent recovery issues. To overcome these, we need solvent

Presenter: **Jhansi MAMILLA, National Institute of Chemistry, Ljubljana, SLOVENIA REPUBLIC**

Presenter's biography:

I am currently working on valorization of biomass to fine chemicals.

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Session reference: 3BO.7.1

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

### **Simultaneous Production of Furfural and Levulinic Acid from Pine Sawdust via Acid-Catalysed Mechanical Depolymerization and Microwave Heating**

Short introductive summary:

In this work pine sawdust was converted into important platform chemicals, levulinic acid (LA) and furfural. Sawdust was first pre-treated with efficient acid-catalysed mechanical depolymerization, which combines ball milling and acid catalysis by H<sub>2</sub>SO<sub>4</sub> (conc.). The milling (1-3 h) was performed with alternating 1 min milling and 1 min pausing sequences.

The conversion reactions were performed with microwave (MW) heating (10-60 min) at 180 °C. To enhance the furfural yield and the efficient separation of furfural and LA, biphasic water-toluene reaction system was used. The effect of an additional catalyst, AlCl<sub>3</sub>, on the yield of LA and furfural was also studied.

According to the preliminary results the pre-treatment method enhanced the yields of LA and furfural. In addition, the efficient MW heating method reduced the reaction times considerably compared to conventional heating methods. AlCl<sub>3</sub> enhanced the LA yield, however excellent furfural yields were achieved even without it. The best LA yield (40%) was achieved with 3 h of milling combined with 30 min of MW heating while the best furfural yield (85%) was achieved with 2 h of milling and 20 min of MW heating.

Presenter: **Katja LAPPALAINEN, Kokkola University Consortium Chydenius, Applied Chemistry, Oulu, FINLAND**

Presenter's biography:

Doctor of Philosophy (organic chemistry) from University of Oulu, Finland in December 2015. Currently working as a post-doctoral researcher in Bioraff Botnia -project. The research includes the chemical conversion of industrial lignocellulosic residues into platform chemicals.

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Session reference: 3BO.7.2

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Enhancing Carboxylic Acid Yields from Duckweed by Acidogenic Digestion

Short introductive summary:

Duckweeds are efficient aquatic plants for wastewater treatment, due to their high nutrient uptake capabilities, growth rates, and resilience to severe environmental conditions. The high starch and cellulose, and low lignin contents of duckweed species make it an attractive alternative for conversion into bioethanol, as it does not require intensive pretreatment prior to saccharification, in contrast to lignocellulosic agricultural residues and energy crops. However, studies on the acidogenic digestion of duckweed into carboxylic acids, which are precursors of higher-value chemicals and biofuels, is lacking. Literature suggests that higher volatile fatty acid (VFA) (i.e., carboxylate) concentrations can be achieved under alkaline conditions of pH 9 to pH 10, which should simultaneously suppress methanogenic activity as desired to avoid VFA loss. Yet, the behavior of acidogenic microbial consortia of high pH is not well understood. This study aims to evaluate the effects of operating conditions such as temperature (35°C or 55°C) and pH (5.3 or 9.2) on the acidogenic digestion of duckweed, to quantify conversion rates, and to identify shifts in dominant microbial taxa.

Presenter: **Ozgul CALICIOGLU, The Pennsylvania State University, Civil and Environmental Engineering Dpt., State College, USA**

Presenter's biography:

Obtained a B.S. degree in Business Management, B.S. and M.Sc. degrees in Environmental Engineering. Currently, I am a Ph.D. candidate at Penn State University Department of Civil and Environmental Engineering, working on techno-economic and environmental feasibility of waste-to-energy systems.

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Session reference: 3BO.7.3

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Production of Advanced Hydrochar without Phytotoxic Properties

Short introductive summary:

In the Climate KIC project CharM it has been confirmed that hydrochar possesses a climate change mitigation potential when applied to soils, depending on geographic location of the plant and hydrochar's ability to increase crop productivity in the long term. However, during the initial period after application, pristine hydrochar exerts a plant growth retarding effect caused by toxicity of organic compounds present in the hydrochar. Herein we show that this effect can be eliminated by a simple finishing step based on thermal treatment. The latter can be incorporated easily into the actual production process, producing advanced hydrochar. An additional, mainly organic, stream is produced which can be valorized energetically, decreasing the dependency of the plant from external heat sources. Furthermore, this usage avoids undesired waste streams with a potential environmental concern. In conclusion, an economical concept is presented which paves the way to produce advanced hydrochar, which can be employed for soil amendment to increase crop productivity while mitigating climate change. This is a breakthrough for valorization of wet lignocellulosic resources.

Presenter: **Michael RENZ, Universitat Politècnica de Valencia, Institute of Chemical Technology, Valencia, SPAIN**

Presenter's biography:

M. Renz received his PhD at the University of Würzburg, Germany. He joined the ITQ (UPV-CSIC) in 1999. His research interests involve heterogeneous catalysis and biomass conversions, especially hydrothermal carbonization. Hydrochar for soil application products and bioplastic (thermoset resins).

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 3BO.7.4

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Bioconversion of Wheat Straw into Value-Added Products by Evolved Kluyveromyces Marxianus Strain**

Short introductive summary:

This work applied an evolutionary approach through sequential transfer method, in a non-conventional *Kluyveromyces marxianus* yeast to improve the consumption of pentoses at 40 °C and also to improve the yeast tolerance to furan derivatives, aliphatic acids, and phenolic compounds. The evolved strain was exploited to produce xylitol and aroma compounds such as 2-phenylethanol, ethyl acetate, and isovaleric acid. The experiments were performed in synthetic media with and without inhibitors, and in hydrolysate medium obtained by hydrothermal pre-treatment of wheat straw. Aroma compounds and xylitol were highlighted produced in the presence of inhibitors, and the evolved strain showed preference to consume pentoses.

Presenter: **Celina YAMAKAWA, DTU, Biosustain, Kongens Lyngby, DENMARK**

Presenter's biography:

Celina K Yamakawa is chemical engineer with background to develop innovative technologies to transfer to production sector. Today she is acting as Postdoc at DTU Biosustain.

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Co-authors:

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Session reference: 3BO.7.5

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Alternative Aviation Fuels: Assessment of Supply Potential in the Eu**

Short introductive summary:

The paper defines the current EU biojet potential and estimates the 2020 and 2030 figures. In the article the perspective of biojet supply is presented, with the aim to opening up the discussion on the sustainable feedstock availability, also considering potential upcoming mandates for aviation and the consequent expected competition with road transport biofuels demand.

Presenter: **Matteo PRUSSI, JRC-Ispra, Unit C.4, Ispra, ITALY**

Presenter's biography:

**Matteo Prussi**

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Session reference: **IBO.8.1**

Subtopic: **6.5 Policy**

Topic: **6. INDUSTRY SESSIONS**

## Bioenergy's Additional Values

Short introductive summary:

At EUBECE 2018, I would like to speak about Bioenergy's additional values for jobs, rural area development, CHP as effect balance and how Sweden, through the introduction of our carbon tax, today has evolved into a leading welfare state where one third of total used energy comes from biomass. (Even 20% of our automotive fuels are non-fossil). With focuses on the arguments often lost in the global discussions surrounding electrification.

Please let me know if this is of interest, if so, I will return with more detailed information.

Presenter: **Bengt- Erik LOFGREN, Swedish Pellet Association, Lidköping, SWEDEN**

Presenter's biography:

Bengt-Erik Löfgren, Coordinator of Swedish Pellet Association. He is also CEO and founder of ÄFAB in Sweden, and has since 1984 worked in the borderland between academia and enterprise. Mr. Lofgren is one of the best known experts in small- and medium scale bioenergy in Sweden.

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Co-authors:

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Session reference: IBO.8.2

Subtopic: 6.5 Policy

Topic: 6. INDUSTRY SESSIONS

## The Future Role of Biogas Energy in an Integrated Renewable Energy Dominated Energy System

Short introductive summary:

Bioenergy and especially biogas technology will play a central mediating role as a virtuoso storage medium in spatial and temporal scales for the future predominant intermittent renewable energy sources. At the same time, bioenergy and especially biogas technology will take up a central interface in a bioeconomy based on closed-loop economy, which it solves disposal problems, closes nutrient cycles and converts waste into energy. Based on numerous examples from one of the leading renewable energy regions in Germany as well as from developing countries, this central function of bioenergy is to be demonstrated. It shows what an enormous role it plays in increasing energy and resource efficiency, improving animal health and reducing environmental pollution.

Presenter: **Jens BORN, Jahr, Chemical Technology, Flensburg, GERMANY**

Presenter's biography:

Since 1995 professor of chemical technology of renewable resources  
2006 to 2012 guest professor biorefinery and green engineering Aalborg University Esbjerg  
Since 2012 guest lecturer in Bioenergy University of the West Indies

1988 to 1994 chemical process industries

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Session reference: IBO.8.3

Subtopic: 6.5 Policy

Topic: 6. INDUSTRY SESSIONS

## Biofuels for Sweden 2030

Short introductive summary:

Biofuels for Sweden 2030 makes biofuel available on a large scale across the country at a reasonable cost. The vision is that biofuels will quickly become an important alternative in the transport sector. It is a decisive step on the road to a fossil-independent vehicle fleet, a fossil-free shipping and a fossil-free domestic flight 2030.

Presenter: **Anton FAGERSTRÖM, Energiforsk, Transport and fuels, Malmö, SWEDEN**

Presenter's biography:

Project and program manager at Energiforsk.

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Co-authors:

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Session reference: IBO.8.4

Subtopic: 6.5 Policy

Topic: 6. INDUSTRY SESSIONS

## The AGRANA Starch Biorefinery Coproducing Highly Sustainable Bioethanol, Food, Feed and Chemicals for the Bioeconomy

Short introductive summary:

In Pischelsdorf/Austria a starch biorefinery is in operation to coproduce food, feed, bioethanol and chemicals from an annual wheat input of about 250,000 t. The products are starch, bran, gluten, 3 types of animal feed, bioethanol and liquid biogenic CO<sub>2</sub>. The purpose of the work was to analyse and assess the life cycle based sustainability of this starch biorefinery in comparison to two reference systems covering technical, economic, environmental indicators. Additionally for the bioethanol the GHG calculation according to the Renewable Energy Directive (RED) is applied. Based on the technical and economic characteristics of the single processes the mass, energy and cost balance of the whole value of the starch biorefinery starting with the agricultural land to cultivate wheat to the supply of the product services were calculated. Based on these technical and economic characteristics the method of Life Cycle Sustainability Assessment (LCSA) was applied to quantify the most relevant sustainability indicators. In parallel two realistic reference systems were identified that provide the same product services, e.g. gasoline instead of bioethanol.

Presenter: **Gerfried JUNGMEIER, Joanneum Research Centre, Research Centre for Climate, Energy and Environment, Graz, AUSTRIA**

Presenter's biography:

Highlights of professional experiences:

- life cycle assessment of bioenergy for transport, electricity, heat and biorefineries
- greenhouse gas assessment of products and services
- sustainability assessment and future scenarios for transportation fuels of the future iV biofuels, e-mobility and hydrogen
- Austrian Representative in activities of the International Energy Agency (IEA) on "Bioenergy", "Hybrid and Electric Vehicle (HEV)" and "Alternative Motor Fuels (AMF)"

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Session reference: IBO.8.5

Subtopic: 6.5 Policy

Topic: 6. INDUSTRY SESSIONS

## Regional Feasibility of Biomass-Based Small-Scale CHP Production

Short introductive summary:

The focus of this paper is to study the regional operating conditions for small-scale biomass-based CHP production in the Finnish rural areas. The study was based on interviews and online survey directed to potential small-scale energy producers such as farms and small enterprises. The aim was to analyse the operating environment and possibilities, obstacles and challenges in generalisation of small-scale CHP production.

Presenter: **Mika LAIHANEN, Lappeenranta University of Technology, LUT Energy Dpt., Lappeenranta, FINLAND**

Presenter's biography:

Mika Laihanen, M.Sc. (Eng.), works as a project researcher at Lappeenranta University of Technology. His main research subjects are biomass availability, utilization and regional energy balances.

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Session reference: 5BV.3.3

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS



**Challenges for Biogas Production and Use in Brazil and Lessons to Learn From Denmark**

Short introductive summary:

Nowadays, there are not so many experiences with biogas conversion to energy in Brazil. However, there are several initiatives from state governments aiming to incentivize the injection of biomethane into the natural gas grid. Recently, the Federal Regulatory Agency for Oil and Biofuels (ANP) has defined parameters for quality control of biomethane from landfills and sewage stations to be used in the transport sector, as well as for residential, industrial and commercial uses all over the country. On the other hand, a new Danish legislation from 2012 has formed a new growth momentum to upgrade and integrate biomethane in the natural gas grid for industrial and transportation utilisation. This experience and gained knowledge could be applied to the Brazilian scenario. We also analyse the feasibility of using co-digestion and integrate large-scale biogas plants to sugarcane mills, addressing the environmental issues that appear. This study shows that there is a need for further case studies and demonstration plants to overcome technological, political, economic and cultural challenges.

Presenter: **Bruno CARMO, Universidade de São Paulo, Mechanical Engineering, São Paulo, BRAZIL**

Presenter's biography:

Degree in Mechatronics from the University of São Paulo (2002), MSc in Mechanical Engineering at the University of São Paulo (2005) and PhD in Aeronautics at Imperial College London (2009). Assistant Professor at the Department of Mechanical Engineering of Poli-USP since 2010.

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Session reference: 5BV.3.4

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

**Power-To-Gas Integration to Biogas Generation from Vinasse in Sugarcane Ethanol Industry**

Short introductive summary:

Concerns about climate change have motivated the quest for less carbon intensive technologies. In the energy sector, this explains the increasing use of renewable energy sources, especially solar, wind, and biogas/biomethane. However, sources like solar and wind are variable, causing challenges in supply-demand grid balance. Consequently, measures to increase grid flexibility are required, including the use of energy storage technologies. Power-to-gas is a promising one, providing seasonal storage as well as converting electricity into a different energy carrier that can be used outside the electricity sector, contributing to the energy convergence of electricity, gas and transportation sectors. This work studies the potential integration of power-to-gas to biogas generation from vinasse in sugarcane ethanol industry in Brazil. The goal is to integrate renewable electricity surpluses, transformed into hydrogen, which is used to convert biogenic CO<sub>2</sub> from biogas generation process into biomethane. This study consider that biomethane can displace fossil fuels, particularly diesel, from transport applications in sugarcane ethanol industry, mitigating CO<sub>2</sub> emissions.

Presenter: **Suani COELHO, University of São Paulo, Institute of Energy and Environment, São Paulo, BRAZIL**

Presenter's biography:

Short bio.

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Session reference: 5BV.3.5

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

**The Perspectives of Biomethane to Contribute to Increase the Natural Gas Supply in the State of São Paulo**

Short introductive summary:

The Intended Nationally Determined Contribution from Brazil presented in COP 21 was ratified on 2016 by the Brazilian Congress and establishes two main goals to be achieved by Brazil related to carbon emissions: reduction of 43% compared to 2005 by 2030 and increase the share of biofuels in the Brazilian Energy Matrix up to 18% by 2030. On the other hand, since 2009 the São Paulo State Climate Policy, aims towards 20% reduction on GHG emissions by 2020 compared to 2005. In this scenario, biogas and biomethane are suitable renewable fuels to meet such goals. Thus, the Bioenergy Research Group of the Institute of Energy and Environment at the University of São Paulo (GBIO/IEE/USP) developed "Project 27 - The biomethane contribution prospects to increase the supply of natural gas in São Paulo" to obtain and map the biogas and biomethane potentials in São Paulo.

Presenter: **Suani COELHO, University of São Paulo, Institute of Energy and Environment, São Paulo, BRAZIL**

Presenter's biography:

Short bio.

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Session reference: 5BV.3.10

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

## **Bioenergy System and the Potential for Their Integration for Village Energy Self Sufficiency**

Short introductive summary:

I am a research Scholar at the top engineering institute in India and working on energy self sufficiency of villages by utilizing locally available resources.

Presenter: **vandit VIJAY, IIT Delhi, New Delhi, INDIA**

Presenter's biography:

I am a Ph.D. student at the Indian Institute of Technology Delhi. My research focus is on assessment and utilization of locally available surplus biomass resources in rural areas for meeting the basic energy demands of rural areas to make them more energy self-reliant.

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Session reference: 5BV.3.11

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

**Gas Electric Hybrid Heat Pumps - A Socio- and Private Economic Feasibility Study**

Short introductive summary:

The electrification of sectors utilizing fossil fuels is one of the approaches to a 100% renewable energy system. Therefore, new sources of emission free and flexible energy loads and producers are crucial to the future Danish energy system. The heating sector holds a large potential for flexible power consumption. For this purpose, Gas Electric Heat Pumps (GEHP's) can assure a fully flexible operation of electric heat pumps subsidizing electricity with biogas when these heat pumps can offer load balancing services to the power grid. Gas electric heat pumps are individual heat pumps consisting of an electric heat pump and a gas boiler. The gas infrastructure is well developed in Denmark. Utilizing this infrastructure offers a cost-efficient solution path to a 100% renewable based energy system. In this paper we analyse the feasibility of this technology on the example of skive municipality in Denmark.

Presenter: **Tara SABBAGH AMIRKHIZI, DTU, Management Engineering, Lyngby, DENMARK**

Presenter's biography:

PhD student at the System Analysis Division of the DTU department of Management Engineering. I am working for the FutureGas project, a project that is studying the future role of gas in Denmark and the integration of green gases into the danish energy system.

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Co-authors:

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Session reference: 5BV.3.14

Subtopic: 5.2 Technological options for energy grid balancing

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

**On-Demand Biogas Production from Intermittent Feeding of Sugar Beet Silage in Co-Fermentation with Maize Silage**

Short introductive summary:

On-demand energy, e.g. generation when electrical power if needed, can be achieved by just-in-time biogas production. One option is a specific feeding management with easily degradable substrates such as sugar beet silage. In this study co-fermentation of maize silage (M) with sugar beet silage (S) was tested using intermittent feeding of beet silage every 12 hrs in parallel to hourly feeding of maize silage. This set-up was tested using four different feedstock ratios of M:S 1:0, 6:1, 3:1 and 1:3 (based on volatile solids).

Increasing share of sugar beet silage raised the maximum biogas production from 0.42, and 0.50 to 0.78 IN hr<sup>-1</sup> at the ratios of M:S 6:1, 3:1 and 1:3, respectively. By contrast, the reactor with only maize silage (M:S 1:0) produced biogas at 0.31 IN hr<sup>-1</sup>. Methane concentrations were constant at all feedstock ratios other than at M:S 1:3. At prevailing sugar beet silage input, methane concentration decreased 2 hrs after substrate input but recovered later. For all treatments, there was no delay between biogas and methane production. Hence, the study revealed the potential of sugar beet silage in demand-based energy production.

Presenter: **Kerstin MAURUS, Ulm University, Institute for Systematic Botany and Ecology, Ulm, GERMANY**

Presenter's biography:

pHD student at Ulm University (Germany), working on: on demand biogas production using sugar beet silage as a fast degradable substrate

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Session reference: 5BV.3.15

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

## **Optimization of Combustion in Modern Wood Stoves Resulting in High Efficiency Stove with Low Emissions**

Short introductive summary:

In studies carried out by the Danish Technological Institute, it has been found that several parameters and their interplay are crucial for obtaining an optimal combustion with low emissions in modern wood stoves. It is essential that enough air to obtain complete combustion can be provided through the stoves air supplication system at all stages of the combustion cycle, and that it is supplied to the proper places in the fire. However, this is not sufficient as the combustion chamber size must be fitting as well, just as the blending and retention time are key parameters. It is thus necessary to optimize these individual parameters as well as ensuring that the overall stove is performing well. In this study various parameters have been optimized and a new low emission combustion chamber designed.

Presenter: **Morten Gottlieb JESPERSEN, Danish Technological Institute, Biomass and combustion technology, Aarhus, DENMARK**

Presenter's biography:

Morten Gottlieb Jespersen – Head of Section of Biomass and Combustion technology at Danish Technological Institute. Works within the area of biomass boilers, stoves and biomass for combustion.

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Session reference: 2BV.4.1

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Assessment of Organic Micropollutants (Pcdd/fs and Pcb's) from Biomass Combustion in a Small Chp Facility**

Short introductive summary:

Combustion of lignocellulosic biomass in small CHP facility is an important system for distributed renewable energy generation and particular attention must be paid to the environmental impact in terms of pollutant emission. This study concerns the assessment of organic micropollutants produced from combustion of energy crops, elm and poplar, in a cogeneration demonstration facility based on a moving-grate furnace of 350 kWth. The research is aimed at investigating the relationship among the characteristics of biomass, the combustion parameters and the content of polychlorinated dibenzodioxins, polychlorinated dibenzofurans (PCDD/Fs) and polychlorinated biphenyls (PCBs). Results showed that values of PCDFs and PCBs were higher than the limit of detection (LOD) while PCDDs were negligible.

Presenter: **Francesco GALLUCCI, CREA-IT, Monterotondo, ITALY**

Presenter's biography:

Researcher at the Council for agricultural research and economics - Research Centre for Engineering and Agro-Food Processing (CREA-IT). He works on the energy conversion of biomass (combustion, gasification and anaerobic digestion). Authors of more than 40 scientific publications.

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Session reference: 2BV.4.2

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



## Emissions of Particulate Matter from AgroPellets Combustion

Short introductive summary:

The article will address issues of PM emissions production. It will summarize the conclusions of already published papers, which usually refer only to the total measured values of PM emissions. The core part of the article will constitute of the results of the combustion tests, depending on several factors.

The tests were carried out in several types of combustion chambers and burners with pellets of different sizes. However, the main comparison criterion is the fuel used and the chemical composition of its ash. Samples of grain and rape straw, sorrel, hay, sunflower, and millet were used. Collected ash samples were analysed – the size and chemical composition of the particles. Subsequently, the individual dependencies were evaluated; in particular the influence of the fuel composition and its mineral content on the production of PM emissions.

We prefer poster presentation.

Presenter: **Martin LISÝ, Brno University of Technology, FME, Energy Institute, Brno, CZECH REPUBLIC**

Presenter's biography:

2002–2009 PhD degree in Design and Process Engineering at the Faculty of Mechanical Engineering, Brno University of Technology

March 2011–present Assistant Professor at the Energy Institute, Faculty of Mechanical Engineering, Brno University of Technology

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Session reference: 2BV.4.3

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Method to Monitor the Function of Electrostatic Precipitators in Biomass Combustion Plants by Capturing the Operation Parameters**

Short introductive summary:

Electrostatic precipitators are secondary equipment often used for reducing particle emissions in biomass combustion plants to achieve legislative limits of dust emissions as dictated by the government. The EU-directive 2015/2193 demands for a continuous verification of the effective operation of medium combustion plants (MCP), which has to adhere to the national guidelines of every European country. In addition, this will also be necessary and beneficial for small scale plants used for domestic or isolated supply applications in the near future. State of the art online dust particle measurement techniques, using optical signals, have to withstand harsh measurement conditions like high temperature, electrostatic charge and corrosive particles. Therefore, they are too expensive to be used in this context. However, using the operational parameters such as current and voltage, the precipitator itself can predict the emitted dust concentration directly through a mathematical method. This eliminates the need for higher investments and offers a simple and continuous verification of the plant as to whether it reaches the emission goals or not.

Presenter: **Bastian ALT, Technical University of Munich, Associate Professorship of Regenerative Energy Systems, Straubing, GERMANY**

Presenter's biography:

Education:

1999 - 2008: General qualification for university entrance, "Gymnasium Fränkische Schweiz" Ebermannstadt

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Session reference: 2BV.4.4

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## The Biomass Dust-Fueled Engine

Short introductive summary:

Ultrafine Wheat Straw and Pine Bark powder has been used directly as fuel in an internal combustion engine on an engine test bench. Emissions, performance and combustion analysis data show the feasibility of solid biomass powder as a low-tech 2nd generational biofuel for energy production.

Presenter: **Luke STOVER, CIRAD, BioWooEB, Montpellier, FRANCE**

Presenter's biography:

Luke Stover is a PhD student based at CIRAD in Montpellier, France originally from New York State. Stover's PhD is in solid fuel engines at the Université d'Orléans. His previous degrees are in physics education and automotive engineering from the United States, New Zealand and France.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 2BV.4.5

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Present and Future of Mixed Pellets Based on Agricultural Crops Residues (Herbaceous and Woody) for Their Use in the Residential Sector (Mhwpellet Project)**

Short introductive summary:

Growing energy demands regarding the thermal use of biomass in Spain indicate that new biomass sources such as agricultural crops residues (including energy crops and prunings) should be considered in the solid biofuel energy mix. Nevertheless, it is widely known that the use of these sources requires new challenging developments regarding their energy conversion to guarantee their sustainable use.

In this paper, the MHWPellet project is going to be presented. The main objectives of this project are: 1) to develop an advanced methodology for the definition of optimal mixed pellets (based on predictive methods and validated by combustion tests) of agricultural crops residues; 2) to determine, for the previously optimised mixed pellets, the influence of selecting operating conditions (at reactor and commercial scale units) on the ash matter behaviour and the global performance of the system (efficiency, operation and emissions of pollutants)

Not only the objectives of the MHWPellet project, the methodology and the available facilities will be presented, the first results obtained in the research will be included.

Presenter: **Paula CANALIS-MARTINEZ, Universidad de Zaragoza, Ingeniería Mecánica, Zaragoza, SPAIN**

Presenter's biography:

My name is Paula Canalís-Martínez from Spain. I am a PhD in Industrial Engineering from the University of Zaragoza, where I am working as a professor in the Mechanical Engineering Department. Nowadays I am researching the use of mixed pellet based on agricultural crops residues

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 2BV.4.6

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Effect of Dewatering Wood Derived Pyrolysis Liquid Biofuel on its Properties, Characteristics, and Combustion Behavior in a Diesel Engine for Power Generation**

Short introductive summary:

We have investigated the effect of water removal on the utilization of wood derived pyrolysis liquid (bio-oil) in diesel engine for power production . Removing water reduced pyrolysis liquid acidity and improved its heating value. Several other key physical properties were improved except viscosity. Therefore, procedure were developed to emulsify pyrolysis liquid with diesel in the presence of surfactants. These emulsions were then tested for performance and emissions in a four cylinder 4-stroke 24.1kW diesel engine.

Presenter: **Muhammad KHAN, University of Toronto, Mechanical and Industrial, Mississauga, CANADA**

Presenter's biography:

I am PhD student at the University of Toronto. My research involves use of pyrolysis liquid in diesel engines for power generation.

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Session reference: 2BV.4.7

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **A Comparison of Selected Latent Heat Storage Configurations for Wood Stoves**

Short introductory summary:

The objective of the current study was to investigate numerically different configurations to implement latent heat storage to wood stoves.

Presenter: **Øyvind SKREIBERG, SINTEF Energy Research, Thermal Energy Dpt., Trondheim, NORWAY**

Presenter's biography:

Dr. Øyvind Skreiberg is Chief Scientist within stationary bioenergy at SINTEF in Trondheim, Norway, having 25 years of broad bioenergy experience, contributed to more than 500 scientific publications, presentations and reports and representing Norway since 1998 in IEA Task 32.

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Session reference: 2BV.4.8

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Biomass Conversion with a Fluidized Bed-Fired Stirling Engine in a Micro-Scale CHP Plant**

Short introductive summary:

Up to now, major quantities of solid biofuels are still unexploited for small-scale power generation. Combining small fluidized bed combustion chambers with an in-bed heat exchanger, e.g. of a Stirling engine, is a promising concept for mini- and micro-scale CHP plants. In the project "BioWasteStirling" a pilot CHP-system consisting of a 45 kW<sub>th</sub> fluidized bed combustion and a 5 kW<sub>el</sub> Stirling engine is developed and operation performance with various woody biomass and further challenging biogenic residues is examined in field testing. This conference contribution will present and explain the innovative micro-scale CHP concept, summarize previous experimental results from an existing lab-scale plant, as well as preliminary results from initial operation of the pilot plant.

**Presenter:** **Tanja SCHNEIDER, Friedrich-Alexander-University Erlangen-Nuremberg, Chair of Energy Process Engineering, Nürnberg, GERMANY**

Presenter's biography:

Professional:

- since 2017: Research Associate, Chair of Energy Process Engineering, FAU Erlangen-Nürnberg
- 2011-2014: Trainee Industrial Eng., Air Liquide GmbH

Educational:

- 2014-2014: M. Sc. Chemical Engineering, FAU Erlangen-Nürnberg
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Session reference: 2BV.4.9

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Experimental Investigation of an Integrated Energy System for a Domestic-Scale Sanitation System**

Short introductive summary:

Poor sanitation is one of the persistent problems facing the world. More than 2.4 billion people in the world are reported to have no access to improved sanitation services and about 1 billion defecate in the open. As such, there is a global concerted effort to develop affordable, sustainable, off-grid sanitary systems, particularly for developing economies. At Cranfield University, an on-site sanitation facility, also known as the 'Nano Membrane Toilet' (NMT) — Figure 1, is being developed to safely treat human excreta and recover useful by-products such as clean water and energy. For self-sustaining energy supply and environmental-friendliness, the facility will employ an integrated energy conversion system to thermally treat the faecal sludge under a minimum power requirement and emission profile. This requires an optimised operation of the fuel-feed, heating and ash-removal systems.

Presenter: **Tosin ONABANJO SOMORIN, Cranfield University, Energy & Power, Bedford, UNITED KINGDOM**

Presenter's biography:

Tosin is actively contributing to the development of the Nano-Membrane Toilet, a project funded by the Bill and Melinda Gates Foundation and designed for people lacking access to modern sanitation.

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Session reference: 2BV.4.11

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



**Semi-Mobile Bioenergy from Agricultural and Forest Residues in Chile**

Short introductive summary:

The German-Chilean research project 'Semi-Mobile Bioenergy from Agricultural and Forest Residues in Chile and beyond' aims at developing feasible concepts for regional bioenergy chains. One part of the project is to use mobile Thermo-Catalytic Reforming (TCR®) units to convert biogenic residues into high quality fuels directly at the facility where the residues occur. The TCR® is an intermediate pyrolysis combined with a unique integrated catalytic reforming step. Within the scope of the project, a TCR® plant with a capacity of 2 kg/h will be containerized and connected with a CHP to utilize gas and oil. The plant will be operational in the first quarter of 2018 in Chile. Within this framework, several preliminary trials with feedstocks from Chile were carried out at the Fraunhofer UMSICHT facility. Various biogenic and industrial residues like forestry and agriculture residues were successfully tested. The products carbonisates, gas, and oil were characterized and the high quality has been proved in several downstream and upstream processes like CHP, gasifier, and HDO treatments to produce transport fuels.

Presenter: **Samir BINDER, Fraunhofer-Institut UMSICHT, Sulzbach-Rosenberg, GERMANY**

Presenter's biography:

Samir Binder holds a degree in aeronautical engineering. Since 2009 he has worked as head of the department of Renewable Energy and head of operations at the Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT in Sulzbach Rosenberg/Germany.

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Session reference: 2BV.4.12

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Particulate Matter Emission and its Chemical Species from Co-combustion of Lignite and Agricultural Residues**

Short introductive summary:

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Presenter: **Suthum PATUMSAWAD, National Science and Technology Development Agency, Cluster and Program Management Office, Pathum Thani, THAILAND**

Presenter's biography:

Dr. Suthum Patumsawad is working at Department of Mechanical Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok. He is also working as Director of Renewable Energy Program, National Science and Technology Development Agency (NSTDA).

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Session reference: 2BV.4.13

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Influence of the Grate on Performance of a Downdraft Household Stove**

Short introductive summary:

The contribution of household fire stoves to the overall particulate matter emissions and especially to violation of daily emission limits is significant.

Particulate matter and gaseous emissions measured under optimal approval testing conditions are far from those in typical operation. For this reason there is a need for new test methods corresponding to the real usage of stoves. A downdraft stove is tested according to a 'real-life' procedure and the reference procedure according to DIN EN 13240.

For a downdraft stove it is assumed, that the grate has a big influence on the performance. Therefore, the grate is in the focus of this investigation. On a test rig in accordance with the DIN EN a downdraft stove is operated with different grates under these two procedures. Data are compared with approval data for the stove.

Preliminary results show that the approval data cannot be reproduced yet. Test runs with throttled air supply at minimum load show the highest emissions.

Presenter: **Jörg HO, Fachhochschule Südwestfalen, Meschede, GERMANY**

Presenter's biography:

10/89 – 10/96 : Uni Karlsruhe, Degree : Dipl-Ing. (Master)

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05/98 – 07/01 : Research assistant, Uni Kassel

08/01 – 02/14 : Technical staff member, Uni Kassel

03/14 – 07/14 : Assistant professor, Uni Kassel

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Session reference: 2BV.4.14

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Performance and Evaluation of Combustion Tests on Raw and Torrefied Biomass Fuels: Application in Small And Medium-Scale Domestic Furnaces**

Short introductive summary:

The aim of the paper is to describe an integrated approach in order to enhance the utilization of various types of biomass feedstock, such as straw, sunflower and millet husks in residential/communal heating applications. The project focus on the whole process chain with special regards on the European and Russian market. Since this biomass has no favorable properties for a direct utilization, a pre-treatment via torrefaction and subsequent densification/pelletization is carried out.

The study was carried out within the framework of the EU ERA.NET RUS Plus funded project 'A novel approach for the implementation of TORrefaction in Residential and COMmunal heating Boilers'

**Presenter:** **Dimitrios-Sotirios KOURKOUMPAS, CENTRE FOR RESEARCH & TECHNOLOGY HELLAS, Chemical Process & Energy Resources Institute, Maroussi, Athens, GREECE**

Presenter's biography:

Mr. Dimitrios-Sotirios Kourkoumpas is a research engineer at CERTH. He is a MSc Mech. Engineer with MSc diploma in Energy and Environmental Management. He is specialized in biomass and waste to energy processes, as well as in the simulation of integrated energy projects, esp. through LCA modelling.

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Session reference: 2BV.4.15

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Reduction of NOx Emissions from Automated Boilers by Multiple Air Staging**

Short introductive summary:

Within recent years the utilisation of „new“ biomass fuels (e.g. agricultural residues and energy crops) in biomass combustion processes has gained relevance. Unfortunately, most of these new biomass fuels are characterised by elevated contents of N, S, Cl as well as ash forming elements. Consequently, compared with the combustion of chemically untreated wood fuels, higher NO<sub>x</sub>-, HCl- and SO<sub>2</sub>-emissions as well as more severe ash related problems (aerosol formation, deposit formation, corrosion, slagging) must be expected. Currently available biomass heating systems for the combustion of non-wood biomass fuels have a high system complexity and cost intensive secondary measures have to be applied to keep strict emission limits. Thus, emission reduction by primary measures can be a meaningful and economically attractive solution for the development and design of biomass combustion systems.

Presenter: **Christoph MANDL, Bios Bioenergiesysteme, Graz, AUSTRIA**

Presenter's biography:

Christoph Mandl studied Process Engineering at the Graz University of Technology in Graz, did his PhD at the Graz University of Technology and since January 2010 works as a senior project engineer at BIOS BIOENERGIESYSTEME GmbH in the research department.

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Session reference: 2BV.4.17

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Enhancing the Heating Value of Pretreated Barley Straw

Short introductive summary:

In this study the use of pretreated barley straw in a batch reactor with a dilute sulfuric acid solution and the measurement of the Higher Heating Value (HHV) is a scientific breakthrough. Pretreated barley straw can be obtained as byproduct during the sugar and ethanol production process within the biorefinery concept.

Presenter: **Dimitrios SIDIRAS, University of Piraeus, Industrial Management and Technology Dpt., Piraeus, GREECE**

Presenter's biography:

Prof. D. Sidiras, Dep. Industrial Management & Technology, Univ. Piraeus; 5-year diploma and PhD in chemical engineering, NTUA; Scopus: 48 publications, 690 citations, h-index=12; Google Scholar 93 publications, 1248 citations, h-index=14.

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Session reference: 2BV.4.19

Subtopic: 2.3 Biomass combustion in large utilities

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Wood Pellet Milling Performance in a Suspension-Fired Power Plant**

Short introductive summary:

The objective of this study was hence to quantify and assess the full-scale comminution of two industrial wood pellet qualities in coal vertical roller mills at different operating conditions of the suspension-fired power station unit 1 at Amagerværket in Copenhagen. The milling performance was assessed by determining the specific grinding energy consumption (SGEC), mill pressure loss, and the comminuted product characteristics (i.e. particle size distribution (PSD) and shape) using image analysis by Camsizer X2. Large-scale pellet comminution produced finer PSDs than the (original) disintegrated pellets, but only had a negligible effect on the particle shape. The mill pressure loss, absorbed mill power, and hence SGEC depended on the pellet quality. Decreasing the mill load produced finer PSDs, and reduced the mill pressure loss and absorbed mill power. However, the SGEC was negatively correlated with the mill load. Adjustments of mill operating conditions had a negligible effect on the comminuted wood particle shape.

Presenter: **Marvin MASCHE, Technical University of Denmark, Department of Chemical and Biochemical Engineering, Roskilde, DENMARK**

Presenter's biography:

Born and raised in Berlin, Germany, Marvin is a second-year PhD student at DTU Chemical Engineering in Roskilde, Denmark. His focus is to study the wood morphology and grindability of wood pellets, and their combustion characteristics at pulverized fuel-firing conditions at large-scale CHP plants.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 2BV.4.20

Subtopic: 2.3 Biomass combustion in large utilities

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Modelling Waste Wood Combustion and the Fate of Trace Element Species in a 250 kW Pilot-scale

Short introductive summary:

Due to its abundance, waste wood can potentially contribute significantly to energy productions from solid fuels. However, waste wood contains significant amount of trace elements originated from chemical treatments, such as furniture coatings containing arsenic and copper. This is the major drawback in thermal conversion processes as trace elements released to the atmosphere threatens human health. Based on this context, this research aims to predict trace element occurrence and release concentration during combustion. Furthermore, it evaluates how much waste wood can be burned safely.

The model is based on experimental results of the combustion in a 250 kW down-fired test facility as part of the UKCCSRC Pilot-scale Advanced Capture Technology (PACT) facilities for both air-firing and oxy firing of US White Wood Pellets.

The model predictions for gas temperature profile through the combustor are in good agreement with experimental results. Underway current work focuses on validating trace element occurrence and concentrations in emissions.

Presenter: **Wahyu MEKA, Imperial College London, Chemical Engineering, London, UNITED KINGDOM**

Presenter's biography:

I am a chemical engineering PhD student at Imperial College London. My research is about biomass combustion modelling incorporating trace element equilibrium evaluation and calculation.

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Session reference: 2BV.4.22

Subtopic: 2.3 Biomass combustion in large utilities

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



**Ignition and Combustion of Single Particles of Biomass Under Air And O<sub>2</sub>/CO<sub>2</sub> Atmospheres**

Short introductive summary:

The combination of carbon capture and storage technology with biomass as a carbon neutral fuel could provide a very effective method of CO<sub>2</sub> disposal, hence the interest on biomass oxy-fuel combustion technology.

Various biomass samples combustion have been study on a single particle device with high speed video recording. The images set new evidences on the differences on ignition, volatile release and combustion, char combustion and burnout time. Particles size ranges and average burnout time obtained has been study in order to understand each biomass milling requirements, establishing a maximum size range that would be appropriate for an efficient burnout. The study reflects the effects of O<sub>2</sub>/CO<sub>2</sub> concentration on the overall combustion performance. A worsening of the combustion is observed when replacing N<sub>2</sub> by CO<sub>2</sub>. As Oxygen concentration increase burnout times are reduced. Changes on the shape of the char have been observed during char combustion. Particles were observed to lose the fibrous shape and get more rounded during the last steps of the combustion with a reduction of the aspect ratio.

Presenter: **Juan RIAZA, University of Edinburgh, Institute for Energy System, Leeds, UNITED KINGDOM**

Presenter's biography:

I am Mining Engineer, MSc and PhD in Energy Engineering from the University of Oviedo. I have 7 years of experience in research projects on Biomass energy, I am currently working for Institute of Energy Systems, University of Edinburgh.

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Session reference: 2BV.4.24

Subtopic: 2.3 Biomass combustion in large utilities

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Combustion of Woody Biomass in a Pilot Scale Real Flame Swirl Burner Test Rig

Short introductive summary:

The combustion behaviour of woody untreated biomass with and without additives are investigated with a pilot scale real flame swirl burner test rig with a thermal input up to 200 kW. The flame is assessed with optical and infrared camera systems. Online flue gas analysis, fine particle measurement and deposition tests are carried out. Furthermore are filter- and cyclone ash analyzed.

Presenter: **Richard NOWAK DELGADO, Technical University of Munich, Institute for Energy Systems, Garching, GERMANY**

Presenter's biography:

2017: Research Assistant at Chemical Technology Department at Royal Institute of Technology KTH, Stockholm

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Session reference: 2BV.4.27

Subtopic: 2.3 Biomass combustion in large utilities

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Defining the Temperature Range over which Aluminosilicate Additives Can Capture Volatile Potassium Species during Pulverized Fuel Combustion**

Short introductory summary:

The purpose of this research is to determine the behaviour of aluminosilicate additives in terms of volatile potassium capture rates - during pulverised fuel (PF) combustion - as a function of temperature. This study aims to achieve this by the use of a drop tube furnace and by varying additive ratio and combustion temperature.

Presenter: **David NICHOLS, University of Nottingham, Nottingham, UNITED KINGDOM**

Presenter's biography:

David Nichols graduated from Bangor University, UK in 2014 with a Master of Chemistry (MChem) degree. He is now a research engineer at the University of Nottingham pursuing an Engineering Doctorate (EngD) at their Centre for Doctoral Training (CDT) in CCS and Cleaner Fossil Energies

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Session reference: 2BV.4.29

Subtopic: 2.3 Biomass combustion in large utilities

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Effect of Aluminosilicate-based Additives upon the Resistivity of Biomass Ash**

Short introductive summary:

Aluminosilicate additives have shown promise in mitigating deposition issues in biomass combustion; however little work has been conducted on the effect upon ESP performance. The major effect of particle composition upon ESP performance is related to the electrical resistivity of the material. The resistivity is typically a strong function of temperature, and is heavily dependent upon its structure and composition. Typical optimal resistivity for fly ash collection exists between  $10^6$  -  $10^{10}$   $\Omega\text{m}$ .

The purpose of the present work is to determine the resistivity of various biomass ashes, and the effect of an aluminosilicate additive upon this resistivity. Experiments have been conducted upon three biomass ashes and a power station fly ash, along with various blends of these ashes with an aluminosilicate-based additive. The resistivity is measured over a range of temperatures, between 80°C and 210°C, within the operating range of low temperature ESPs. Linear regression and principal component analysis indicate that, contrary to previous studies, high potassium concentration within the particles will lead to significantly reduced resistivities, potentially impacting ESP performance.

Presenter: **Lee ROBERTS, University of Leeds, Chemical and Process Engineering, Liverpool, UNITED KINGDOM**

Presenter's biography:

Lee is a final year PhD student at the University of Leeds Bioenergy Center for Doctoral Training, with a background in physics. His research focuses on the effect of aluminosilicate-based additives upon the deposition and electrical behaviour of biomass used in large-scale power generation.

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Session reference: 2BV.4.31

Subtopic: 2.3 Biomass combustion in large utilities

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Designing and Assessing Bioeconomy Oriented Cropping Systems

Short introductive summary:

One of the purposes of the “Demonstrating Sites Network” project is to demonstrate whether it is feasible, in the agricultural sector, to produce various sustainable and efficient bioresources in the current cropping systems of Northern France, in order to supply various bioeconomy sectors (food, feed, biogas production, bio-sourced materials, oil and sugar chemical industry). To achieve its objectives, our approach aims at designing oriented bioeconomy cropping systems with a large range of bio resources production (green or dry lignocellulose, fiber, oilseeds) and by using innovative techniques. Each proposed system has to satisfying simultaneous goals: maximizing and diversifying biomass production, meeting farmers and industrial sectors issues, providing additional ecosystem services (organic matter, weed control, soil structure, soil fertility, given the major constraints and agro-ecological targets). According to these guidelines, several bioeconomy scenarios with increasing gradient of biomass production were designed, tested in long-term field experiments and performances are evaluated.

Presenter: **Hélène PREUDHOMME, Agro-Transfert, Estrées Mons, FRANCE**

Presenter's biography:

I started my career with a thesis on the genetic determinants of biomass production in miscanthus. Then I worked for several years in the field of applied research on potato cultivation.

I work today for the development of biomass sectors in Hauts de France

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 1BO.9.1

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES

## **Innovative and Sustainable Intensification of Integrated Food and Non-Food Systems to Develop Climate-Resilient Agro-Ecosystems in Europe and Beyond (SustainFARM)**

Short introductive summary:

SustainFARM was selected for funding in a competitive process among 67 proposals, following an evaluation by an international panel of reviewers: <http://facceturplus.org/joint-calls/first-call/>. SustainFARM is a transnational research project funded by ERA-NET Cofund FACCE SURPLUS (Sustainable and Resilient agriculture for food and non-food systems), in collaboration between the European Commission and a partnership of 15 countries in the frame of the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI). FACCE SURPLUS is committed to improve collaboration across the European research landscape in diverse, integrated food and non-food biomass production and transformation systems, including bio refining.

**Presenter: BB GHALEY, University of Copenhagen, Department of Plant and Environmental Sciences, Taastrup, DENMARK**

Presenter's biography:

Bhim Bahadur Ghaley has a background in molecular plant breeding and agronomy and has extensive experience in field trial planning and execution, agronomy/field crop production, nutrient uptake and utilization, <sup>15</sup>N stable isotope use, cultivar screening for pest and disease and crop modelling.

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Session reference: 1BO.9.2

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

**Biomass for Heat Generation and Wastewater Management in the Agri-food Sector - Are Circular Economy Benefits Realised?**

Short introductive summary:

Short rotation coppice (SRC) willow is commonly grown as an energy crop. SRC willow can also be used as a means of wastewater management in place of conventional wastewater treatment, an application that is currently experiencing increased interest in both the agri-food and water/wastewater sectors. There are multiple benefits to this approach: local wastewater management reduces the economic costs and carbon emissions associated with tankering and/or conventional treatment, demand on conventional wastewater treatment plants is reduced or eradicated, and the nutrients in the wastewater are recycled to fertilise the SRC willow plantation with potential biomass yield benefits. This type of system fits within the concept of the 'circular economy', the goals of which can be broadly described as keeping resources in use for as long as possible, obtaining the optimum value from resources while in use, and recovering and regenerating resources at the end of each cycle. However, while the idea of the circular economy tells a positive story, experience in the biofuels arena has highlighted the importance of thoroughly analysing systems in order to properly assess net impacts.

Presenter: **Beatrice . M. SMYTH, Queen's University Belfast, School of Mechanical & Aerospace Engineering, Belfast, UNITED KINGDOM**

Presenter's biography:

Beatrice's research is focused on the production and use of biomass and biogas as a renewable fuel. Specific areas of work include analysis and optimisation of energy pathways, resource quantification and mapping, energy and carbon life cycle analyses, land use change and economic assessment.

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Session reference: 1BO.9.3

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES

## Biogas Production in Integrated 1st and 2nd Generation Sugarcane Biorefineries: Energy and Economic Prospects

Short introductive summary:

Anaerobic digestion (AD) of vinasse can provide environmental suitability while improving the energy balance of sugarcane biorefineries through biogas use. Energy recovery through AD should also provide more incentives for 2nd generation (2G) ethanol production. Bagasse from 1st generation (1G) ethanol production is currently burned in boilers for combined heat and power generation to supply the sugarcane mill energy demand. Energy from biogas could supply part of such energy, releasing part of bagasse for 2G ethanol production. This work showed that is possible to use bagasse exclusively for 2G ethanol production when integrating an upgraded AD unit for the treatment of 1G2G vinasse. The efficiency of AD process was a critical parameter for the economic viability of an integrated 1G2G sugarcane biorefinery, but the technological level of 2G ethanol production was even more decisive: the prohibitive operational costs of current technologies make the 1G2G sugarcane mill with AD unit an unfeasible business. This work evidenced a profitable opportunity within bioenergy sector, highlighting the need of further R&D on lignocellulosic ethanol production and the AD of its waste

Presenter: **Bruna MORAES, University of Campinas - Unicamp, Interdisciplinary Center of Energy Planning - NIPE, Campinas, BRAZIL**

Presenter's biography:

Degree in Food Engineering (2007), MA and PhD in Hydraulic Engineering and Sanitation (2009 and 2012) - University of São Paulo. Post-doc National Laboratory of Science and Technology of Bioethanol and University of Southern Denmark (2012-2016). Researcher in Bioenergy - NIPE (2016-current).

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Session reference: 1BO.9.4

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES



## The Effect of Sustainable Intensification on Crop Residue Energy Potentials

Short introductive summary:

The use of agricultural residues for energy purposes is seen as increasingly appealing due to its potential to contribute to climate change mitigation without jeopardizing food security. However, the attainable energy potentials and their associated contribution to climate change mitigation may be constrained by other socio-economic or environmental concerns. Sustainable intensification (SI) measures can increase energy potentials while enhancing the socio-economic and environmental sustainability of agro-ecosystems. We explore the effect of SI measures (e.g. varieties with enhanced crop-to-residue ratios, precision fertilization, precision residue removal) on the theoretical, technical, environmental, socio-economic, sustainable, and implementation potentials of crop residues. Our study presents a novel methodology for the spatially and temporally explicit quantification of crop residue potentials combining stakeholder interviews, agro-ecosystem modelling and economic modelling. Results indicate that SI, via location and land-use specific management practices, can play a significant role in increasing potentials while respecting socio-economic and environmental constraints.

Presenter: **Ioanna MOURATIADOU, Utrecht University, Copernicus Institute of Sustainable Development, Utrecht, THE NETHERLANDS**

Presenter's biography:

Ioanna Mouratiadou is a senior researcher at the Energy and Resources group of the Copernicus Institute of Sustainable Development (Utrecht University), working on the assessment of sustainable intensification options of integrated agricultural production of food and non-food products.

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Session reference: 1BO.9.5

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES

## Design and Analysis of Upscaled Twostage Biomass Gasifiers

Short introductive summary:

The TwoStage biomass gasification process is a state-of-the-art gasifier and has been developed for many years at the Technical University of Denmark. Because of some central shortcomings including scalability and flexibility, efforts are now being made to develop the product and allow upscalings in the order of 10-100MWth and increased fuel and air/oxygen flexibility. By applying the principles of: 1) separate pyrolysis and gasification, 2) high internal tar conversion and 3) effective heat integration, it is expected that large-scale systems with very high efficiencies capable of generating gas with very low tar concentrations can be robustly designed. Via extensive product development work, the gasification concept has been re-designed and re-evaluated in order to match future capacities and applications.

Presenter: **Rasmus Østergaard GADSBØLL, Technical University of Denmark, Chemical Engineering Dpt., Roskilde, DENMARK**

Presenter's biography:

With the basis of a mechanical engineering and sustainable energy degree, the author has now been working 3 years as a PhD student within thermodynamic biomass gasification design and the coupling to solid oxide cells.

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Session reference: 2BO.10.1

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Biogas Production from Biological Methanation of Syngas

Short introductive summary:

Biogas production for biomethane vehicle fuel is a highly potential source to meet transport fuel demand and give a significant contribution to the Swedish target: Free fossil fuel traffic by 2030. At present the biogas market is limited by the amount of available organic waste. To overcome this issue, biomass could either be gasified into syngas and then synthesized into bio-SNG through catalytic methanation, or biomass gasification could be integrated into the biogas system to produce methane through biological methanation. Biomass gasification integrated in biological methanation is a relatively new idea and technology. Syngas conversion to methane by anaerobic cultures is practically unexplored, and few reports are available on this subject. Nevertheless, the pathway has been receiving intensive attractions and R&D recent years, and have been commercialized very well based on fossil fuels. For this purpose, a novel pathway by integrating biomass gasification into biogas system is studied in detail. This paper reviews the whole process from integration of biomass gasification into the biogas system to methane production through biological methanation: Biomass gasific

Presenter: **Kristina GÖRANSSON, Mid Sweden University, Department of Chemical Engineering, Sundsvall, SWEDEN**

Presenter's biography:

Kristina Göransson is a Dr. in Chemical Engineering, and her research area is tar-and-methane reforming - in which the impact of catalytic bed material and internal reforming on the synthesis gas quality is studied in detail.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 2BO.10.2

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Entrained Flow Gasification of Biomass in a Pilot-Scale Test Rig: Load- and Fuel-Flexible Operations and Applications**

Short introductive summary:

Entrained flow gasification of biomass is investigated in a pilot-scale test rig. Flexible swirl burners are used to investigate and optimize the flame and gasification behavior depending on different fuel composition (e.g. volatile matter) and load flexibility. Specific case studies are applied for air-blown entrained flow gasification with gas engine for heat and power production in different parts of the world to find suitable application scenarios.

Presenter: **Philipp JOHNE, Institute for Energy Systems, Technical University of Munich, Muenchen, GERMANY**

Presenter's biography:

2010 - 2014 B.Sc. in Chemical Engineering at Technical University of Munich

2013 - 2016 M.Sc. in Chemical Engineering at Technical University of Munich

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Session reference: 2BO.10.3

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Tar Reduction in Producer Gas by Use of Oxygen Transport Membranes**

Short introductive summary:

Oxygen transport membranes are directly integrated into the producer gas stream of a Low Temperature Circulating Fluidized Bed gasifier for the partial oxidation of tar. The oxygen transport membranes are mixed ionic-electronic conducting membranes producing pure O<sub>2</sub> at high operation temperatures (usually 700°C) using the oxygen partial pressure difference across the membrane as driving force.

Presenter: **Maria PUIG-ARNAVAT, Technical University of Denmark, Chemical Engineering Dpt., Roskilde, DENMARK**

Presenter's biography:

Researcher at DTU specialized in biomass pretreatment and pellet production for power plants, thermal gasification of biomass, modelling of thermal energy systems, integration of ceramic oxygen membranes in biomass gasification plants, cogeneration and trigeneration.

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Session reference: 2BO.10.4

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Robust Instrumentation and Control Systems for Gasification of Biomass**

Short introductive summary:

A small downdraft gasifier has been fabricated at the University of Glasgow to act as a test-bed to allow the development and testing of tar detection and control systems and downstream gas cleaning processes. The work on the instrumentation and control is reported in the present study. The Gasifier Control Unit (GCU) is implemented in Arduino (Mega ADK (2560) board, 16MHz clock speed) as an open source platform for monitoring gasification parameters to inform the feedback control loop to optimize the gasification process and efficiency. Monitored parameters include temperature, pressure, mass flow and biomass weight

Presenter: **Prashant KAMBLE, University of Glasgow, School of Engineering, Glasgow, UNITED KINGDOM**

Presenter's biography:

I am an enthusiastic, hardworking and ambitious Ph.D. researcher in Mechanical Engineering at the University of Glasgow. I am working as demonstrator for Demonstrated practical experiments, including briefing, debriefing, and marking of assessed experiments for undergraduate students.

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Session reference: 2BO.10.5

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Bisphenol Replacements from Lignin: on the Intersection of Renewability, Safety, and Functionality**

Short introductory summary:

Novel lignin depolymerisation products such as 4-n-propylguaiacol and -syringol are suitable to design renewable, safe(r), and functional bisphenol replacements.

Presenter: **Steven-Friso KOELEWIJN, KU Leuven, Leuven, BELGIUM**

Presenter's biography:

Steven-Friso Koelewijn obtained his MSc degree in Bioscience Engineering (Catalytic Technology) at KU Leuven (Belgium) in 2013. He is currently in the progress of finishing his PhD degree at the Centre for Surface Chemistry and Catalysis under the guidance of Prof. Bert F. Sels.

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Session reference: 3BO.11.1

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Sustainable Production of Itaconic Acid Using Lignocellulosic Biomass as Carbon Source

Short introductive summary:

The increasing concern on sustainability, environmental conservation and energy shortage drives the search for viable, renewable and environmental friendly alternatives to replace fossil resources in the production of valuable chemicals. Companies all over the world have to meet not only the market demand, but also the biosustainability of their processes and this is the key to make itaconic acid (IA) a real building block platform chemical, starting replacement of oil-based polymers. IA is considered as the cleanest alternative to petroleum-based acrylic acid and can also be used as a co-monomer in the production of some polymers with a wide range of applications in several sectors. Currently, this acid is produced from pure glucose by fermentation with the fungus *Aspergillus terreus*. However, due to the high cost of glucose and the growing market of IA, the search for alternative carbon sources have been encouraged. The purpose of this work was to evaluate the potential of lignocellulosic biomass to serve as a low-cost source of sugars (mainly glucose and xylose) for the production of IA.

Presenter: **Solange MUSSATTO, Technical University of Denmark, Novo Nordisk Foundation Center for Biosustainability, Kongens Lyngby, DENMARK**

Presenter's biography:

Solange Mussatto is Head of Research Group at the Technical University of Denmark. She has 20 years of experience in the areas of Biorefinery and Bioeconomy including Pretreatment and Fermentation of Biomass, Development of Innovative and Sustainable Process Technologies and new bio-based products.

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Session reference: 3BO.11.2

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



**Polyesters and -Amides from Wood: Sugar Conversion to Furan Dicarboxylic Acid And to Muconic Acid**

Short introductive summary:

The total world consumption of polyethylene terephthalic acid (PET) polymers was over 50 million tonnes 2015. Most of this is petroleum based. European Bioplastics has estimated that the overall bio-plastics capacity will grow from 1.7 million tonnes 2014 to 7.85 million tonnes 2019. Most of the growth will come from Bio-PET30. Furan dicarboxylic acid (FDCA) based polyethylene furanoate (PEF) polymers offer bio-based alternative to petroleum based PET polymers. They show 50-60 % lower carbon footprint and better or similar properties compared to PET polymers. PEF polymers have been shown to have 6 times better oxygen barrier, 2 times better CO<sub>2</sub> barrier and 2 times better H<sub>2</sub>O barrier compared to PET polymers.

VTT has developed patented technology to produce FDCA from aldaric acids.<sup>1-3</sup> The technology is based on commercial heterogeneous catalysts. Batch and continuous processes can be used. Aldaric acids can be produced from pectin or glucose by oxidation.

Presenter: **Mona ARNOLD, VTT Ltd, VTT, FINLAND**

Presenter's biography:

Mona Arnold, Business development manager (Tech Lic. and MBA) has a long experience in developing environmental technologies. her current work at VTT relates to creating and commercialising innovations for sustainable chemistry and circular economy

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Session reference: 3BO.11.3

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Why Polyphenols Present in Spent Coffee Grounds Inhibit the Growth of Bacteria Producing Polyhydroxyalkanoates?

Short introductive summary:

Our study aims to suggest detoxification methodology, which would enable to extract phenolic compounds from spent coffee grounds (SCG) hydrolysates to produce inhibitor-free hydrolysates. SCG arises as waste products through the production of instant coffee and coffee brewing. SCG contains oil and lignocellulosic phases, which can be used as carbon substrates for bacteria producing polyhydroxyalkanoates (PHA). Fermentable sugars are transformed from SCG via chemical hydrolysis. However, hydrolysates contain also phenolic compounds, which are toxic for PHA' producing bacteria and partially or completely inhibit their growth. On the other side, coffee polyphenols can be used as antioxidants and antimicrobial agents in many applications. Our results showed that the multi-stepped extractions' methodology enabled to extract phenolic compounds with high antibacterial activity and produce inhibitor-free hydrolysates from which PHA producing bacteria may profit. This work was funded through the project SoMoPro (6SA18032) with funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie and the South Moravian Region (No 66586).

Presenter: **Adriana KOVALCIK, Brno University of Technology, Department of Food Chemistry and Biotechnology, Brno, CZECH REPUBLIC**

Presenter's biography:

Adriana Kovalcik (previous name Gregorova) completed her habilitation in Macromolecular Chemistry and Technology at Graz University of Technology in 2015. In 2017 she has moved to Brno University of Technology as an Invited Researcher due to the receiving of the award Marie Skłodowska-Curie Fellow.

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Session reference: 3BO.11.4

Subtopic: 3.7 Production and application of biobased chemicals

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Crude Tall Oil-Based Renewable Diesel Reduces CO<sub>2</sub> and Tailpipe Emissions Significantly**

Short introductive summary:

The UPM has started to produce crude tall oil based biofuels (diesel and naphtha) at the start of 2015. During the past 2 years UPM's renewable diesel fuel has been tested by various test facilities. These tests include engine and vehicle testing in laboratory condition as well as year long fleet tests. This paper gathers the conclusions from all of these tests.

Presenter: **Ville VAUHKONEN, UPM, Biofuels, Lappeenranta, FINLAND**

Presenter's biography:

Ville Vauhkonen works as a senior technical product specialist at the UPM Biofuels. His responsibility area at the UPM Biofuels is to support the marketing and sales in technical details concerning the fuel products UPM is producing.

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Session reference: IBO.12.1

Subtopic: 6.4 Biochemical Conversion

Topic: 6. INDUSTRY SESSIONS

## Bringing Cellulosic Ethanol to Scale

Short introductory summary:

Clariant's Group Biotechnology has developed the sunliquid process which uses enzymatic hydrolysis followed by fermentation to efficiently and sustainably produce cellulosic ethanol from agricultural residues such as wheat straw, corn stover or sugarcane bagasse. Clariant has been operating Germany's largest cellulosic ethanol plant in Straubing since 2012. In September 2017, Clariant signed its first license agreement on the sunliquid technology for a commercial cellulosic ethanol plant with a production capacity of 50,000 tons.

Presenter: **Paolo CORVO, Clariant, Biofuels & Derivatives, Munich, GERMANY**

Presenter's biography:

Paolo joined Clariant, a Swiss specialty chemicals company, in 2012. As Head of Business Development he oversees the out-licensing of cellulosic ethanol and sugar production plants. Beforehand he worked as Business Development Manager for Biofuels Partners and as Internal Auditor and BD Manager for Aon Insurance. Paolo graduated from the Politecnico di Milano with a degree in Management and Production Engineering in 2000.

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Session reference: IBO.12.2  
Subtopic: 6.4 Biochemical Conversion  
Topic: 6. INDUSTRY SESSIONS

## **The Development and Commercialisation Of Nova Pangaea Technologies' Refnova Process for the Continuous Fractionation of Lignocellulosic Biomass to Sugars and Chemical Precursors**

Short introductive summary:

There is acute global interest in the development both of economically viable cellulosic biofuels, not using food feedstocks, and also for the establishment of new cellulosic value chains for chemicals and pharmaceuticals. In this paper Nova Pangaea Technologies (NPT) describes the chemistry and advanced current state of development and scale demonstration of its unique Refnova™ process addressing this issue, which is now close to commercialisation. A continuous process using only physical and thermochemical steps, so no costly bio-actives or batch processing, this represents an exciting "third generation" approach to biorefineries.

**Presenter: Barry HEDLEY, Nova Pangaea Technologies Limited, Gonville & Caius College, Cambridge University, Middlesbrough TS10 4RG, UNITED KINGDOM**

Presenter's biography:

Former Director of Boston Consulting Group in London; later established strategy consulting firm Braxton Associates and subsequently sold it to Deloitte remaining as global CEO and building it to 1000 consultants in 23 locations worldwide. Chemical Engineer and Fellow at Caius College, Cambridge

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Session reference: IBO.12.3

Subtopic: 6.4 Biochemical Conversion

Topic: 6. INDUSTRY SESSIONS

## Bioforever

Short introductive summary:

14 European companies will demonstrate the feasibility of a commercial scale biorefinery in Europe, using LC feedstock and producing chemical building blocks in the BBI JU funded BIOFOREVER project [www.bioforever.eu](http://www.bioforever.eu)

Presenter: **Anton ROBEK, Bio Refinery Development BV, Brunssum, THE NETHERLANDS**

Presenter's biography:

Studied environmental sciences at WUR. Worked for almost 30 years at Royal DSM in various business positions. Last responsibility within DSM was VP of DSM Bio-based Products and Services, a.o. responsible for Reverdia (production of succinic acid) and POET-DSM (production of cellulosic ethanol).

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Session reference: IBO.12.4

Subtopic: 6.4 Biochemical Conversion

Topic: 6. INDUSTRY SESSIONS

**Bio-Plastics From Lignin is a Key Enabler of a Biorefinery Implementation**

Short introductive summary:

Biorefineries promise to participate in the future sustainable economy through production of multiple products made from perennial biomass. In order to be commercially viable, biorefineries must develop products for multiple markets with sufficient size and value. A consortium of private companies and public research institutes led by the University of Minnesota Natural Resources Research Institute is addressing this need by developing and commercializing solvent fractionated lignin to polymeric products for markets in the durable goods and construction sectors. The lignin produced in this process produces superior polymeric products in terms of mechanical performance and olfactory response, compared with pulp mill lignin. Developing this market sector will offset production costs of cellulosic sugars to make them viable for production of fuel ethanol. The consortium is undertaking a pilot study that will generate process variables, and purity and performance data for the lignin-based bioplastics and cellulosic biofuel production for use in a detailed economic analysis and subsequent commercialization at a deployable cost.

Presenter: **Eric SINGSAAS, University of Minnesota, Natural Resources Research Institute, Duluth, USA**

Presenter's biography:

Eric Singsaas is Wood Products and Bioeconomy director at the Natural Resources Research Institute since January 2016. He previously was founder of the Wisconsin Institute for Sustainable Technology and professor of biology at the University of Wisconsin Stevens Point.

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Session reference: IBO.12.5

Subtopic: 6.4 Biochemical Conversion

Topic: 6. INDUSTRY SESSIONS

**Operational Experience an a Pilot Scale Green Biorefinery, Extracting and Separating Leaf Protein Concentrate for Production of Animal Feed**

Short introductive summary:

A growing global demand for meat protein and increasing European protein dependency on imported soybean meal, has in recent years triggered high interests in new production systems for alternative proteins for food and feed. Agricultural cultivation of grass and legumes are highly efficient and competitive protein production systems, utilizing the entire season for biomass production and reaching up to 2-3 ton protein/ha/yr. We have at Aarhus University developed and operated a green biorefinery pilot plant separating fresh forage biomass into a fibrous pulp and a press-juice, from where soluble protein is precipitated and recovered as protein concentrate. The pilot plant is a platform for optimization, development, process upscaling, and production of products for animal feed trials. The pilot plant operation during the season 2017 resulted in improved input capacities, increased protein fractionation of 20% more protein into the juice by double pressing, observation of a large span of separation efficiencies depending on precipitation method, and a preliminary improved yield of leaf protein concentrate reaching at least 12% DM.

**Presenter: Morten AMBYE-JENSEN, Aarhus Universitet, Department of Engineering, Aarhus N, DENMARK**

Presenter's biography:

Engineer in biotechnology and Ph.D. within biorefinery technology and biomass pretreatment

Research topics:

Extraction and separation of protein from green biomass for feed and food.

Biochemicals from lignocellulosic biomass

Upscaling and process design of pilot/demonstration scale biorefining.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 3BV.5.2

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## **BIOrescue: Getting High Added Value Products from Mushroom Compost**

Short introductive summary:

Spent mushroom compost is the residual compost waste generated by the mushroom production industry. Annually 3 million tons of this residue are generated in Europe resulting in disposal costs of 150 million Euro. The BIOrescue project aims to develop an innovative biorefinery strategy to valorise this promising source of biomass together with other underutilised lignocellulosic feedstocks. This presentation will show the results obtained during the first half of BIOrescue project.

Presenter: **Ines DEL CAMPO, CENER, Biomass Energy Dpt., Sarriguren, SPAIN**

Presenter's biography:

Ms Inés del Campo has a Msc in Chemical Engineer. Since 2002 she has been working in CENER Biomass Department as a Biomass Senior Researcher in Biomass Evaluation and Assessment and Biofuel Production projects. She worked before in CIEMAT Liquid Biofuels Group.

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Session reference: 3BV.5.5

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Liquefied Biomass - A Feedstock for Adhesives and Polyurethanes, a Source of Nanocellulose and a Fuel for Gas Turbine**

Short introductive summary:

Assoc.prof.dr. Matjaž Kunaver finished his MSc at the University of Leeds UK in 1991 and has received his PhD degree in 1998 at the University of Leeds UK. He is a senior scientist – researcher at the National Institute of Chemistry, Laboratory for Polymer Chemistry and Technology, Ljubljana, Slovenia and assistant professor at the University of Ljubljana and Polymer Technology faculty. His main fields of research are the utilization of biomass as a feedstock for polymer synthesis and nowadays production of nanocellulose. He has published more than 50 original scientific papers and 6 patents. He is a member of editorial board of several scientific journals.

Presenter: **Matjaz KUNAVER, National Institute of Chemistry, Polymer Chemistry and Technology Dpt., Ljubljana, SLOVENIA REPUBLIC**

Presenter's biography:

Prof. Matjaž Kunaver finished his MSc at the University of Leeds UK in 1991 and has received his PhD degree in 1998 at the University of Leeds UK. He is a senior scientist – researcher at the National Institute of Chemistry, Laboratory for Polymer Chemistry and Technology, Ljubljana, Slovenia

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Session reference: 3BV.5.6

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Green Residues - A Promising Feedstock for Green Biorefineries? New Findings from the German Smibio Case Study.**

Short introductive summary:

Large-scale biorefineries require high capital costs and often there are barriers for sustainable biomass supply and distribution. Recently, operators of large-scale biorefineries ran into economic problems, bringing this business model into discussions.

Within the SMIBIO Project, the technical-economic and environmental viability of small-scale integrated biorefinery units capable of processing different kinds of biomass is investigated. The feedstock shall be produced in short radius catchment areas of rural and small urban environments.

The results of the German case study, in which residual grass is used as feedstock for a green biorefinery, will be presented. The concept will be analysed to see if this can be a truly sustainable solution, considering chances and challenges of it.

Presenter: **Ingo BALL, WIP Renewable Energies, Unit Bioenergy & Bioeconomy, Munich, GERMANY**

Presenter's biography:

Ingo Ball works as Project Manager at WIP Renewable Energies in the Biomass Department. He holds two degrees: Dipl. Sports Economist and B.Sc. Management of Renewable Energies.

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Session reference: 3BV.5.7

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

**Pre-Treatment of Lignocellulosic Biomass Using Cavitation for Enhancing Biogas Yield**

Short introductive summary:

Biogas production is one of the most mature area in the field of biofuels. Although anaerobic digestion (AD) has been historically used to treat wastewater and organic fraction of municipal solid wastes, this technology has now been extended to treat agricultural wastes. Several pre-treatment technologies have been reported for AD feed streams. Some of the most commonly used pre-treatment methods include size reduction by chopping and milling, steam explosion, acid/alkali hydrolysis and enzymatic/microbial processes which improve the availability of the pentose and hexose polymers in suspension. This will in turn increase the production rate and yields of biogas. These methods mentioned are expensive, energy consuming, slow or environmentally unfavourable. In this work, we report a relatively new pre-treatment method using cavitation. Ultrasonication is one of the methods to generate cavitation. The cavitation would lead to delignification, increase in particle surface area and reduced degree of polymerisation of each fraction of lignocellulosic biomass leading to a positive impact on biogas production during AD.

Presenter: **Sanjay NAGARAJAN, Queen's University Belfast, School of Chemistry and Chemical Engineering, Belfast, UNITED KINGDOM**

Presenter's biography:

Research fellow working on the pretreatment of biomass for biogas production. Previous experience on food waste-biogas production, leach bed reactor design for biogas production, cellulose photocatalysis for fermentable sugar production & photocatalytic reactor design for cellulose photocatalysis.

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Session reference: 3BV.5.9

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**A Novel Closed-Circuit Circulation System about Integrated Ethanol-Methane Fermentation Process Based on the Subcritical Water Pretreatment of Corn Stover**

Short introductive summary:

To fully reutilize wastewater, a novel closed-circuit circulation system of integrated ethanol-methane fermentation process was established, which was the first time for circulation of wastewater produced in second-generation bioethanol process in which subcritical water was used as pretreatment technology. 20 recycling batches were performed to investigate the availability of the process. It was indicated that the pH of recycling liquid decreased with cycle numbers increasing, which led to the constantly enhancement of the efficiency of pretreatment as approximately 60% hemicellulose and 50% lignin degradation as well as more than 80% cellulose reserved. Meanwhile, the performance of both ethanol (2.76 to 6.94 g/L) and methane (382.56 to 2631.24 mL/L) fermentation trended to be stable or self-improved. Furthermore, the variety of microbial community and other processes showed intimate correlation with recycling liquid physiochemical properties. It was promising to apply the system in bioenergy industries to fully reutilize of the wastewater.

**Presenter:** **Xin LU, Northwest A&F University, College of Food Science and Engineering, Yangling, P.R. CHINA**

Presenter's biography:

Ph.D of Jiangnan University, China. Postdoctor of Kyoto University, Japan. Supervise 7 doctoral candidates, 10 master candidates, 1 foreign student. The research group is committed to the use of fermentation engineering theory and technology to solve the problems .

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Session reference: 3BV.5.10

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Combined Production of Polyhydroxyalkanoates (Pha) and 1,3-Propanediol from Crude Glycerol

Short introductive summary:

Crude glycerol is an abundant by-product of the biodiesel industry which can be fermented into volatile fatty acids (VFA) and 1,3-propanediol (1,3-PDO). In the present study, selective conversion of VFA into PHA was achieved in mixed microbial cultures, and 1,3-PDO remained unconsumed. High PHA yields and 1,3-PDO recoveries were achieved.

Presenter: **Anna BURNIOL-FIGOLS, Technical University of Denmark (DTU), Chemical and Biochemical Engineering, Lyngby, DENMARK**

Presenter's biography:

- Bachelor in Biotechnology (Barcelona, Spain)
- 2 years in microbial analysis of microbial communities of bioprocesses (IRTA, Barcelona)
- Master in Sustainable Biotechnology (AAU; Denmark)
- Research Assistant (DTU, Denmark) for 2 years and currently PhD on production of PHA from crude glycerol.

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Session reference: 3BV.5.11

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Cener's Second Generation Biofuels Center: a Key Biofuel Research Infrastructure for Sharing Knowledge**

Short introductive summary:

CENER takes part of BRISK2 project funded by European Horizon 2020. It aims to improve the success of biofuels implementation by: (i) helping to consolidate bioenergy expertise & knowledge; (ii) provide opportunities for international collaboration; (iii) foster a culture of co-operation and (iv) lead to new bioenergy research activities across Europe. The activities that will be developed along the 5 years of the project will include: joint research activities related to biofuels, bioenergy carriers and biorefinery processes multiscale improvement, optimisation and benchmarking, networking activities within all project consortium and provide transnational access (TA) for funding researchers (from institutions not being part of the project consortium) to access to its facilities. More specifically, at CENER's pilot plant TA is offered for the following test rigs: peleting plant, torrefaction pilot plant, gasification unit, prototype pilot plant for biochemical conversion and pilot plant for biochemical processes. This presentation will include updated information about CENER's activities at BRISK2 Project.

Presenter: **Ines DEL CAMPO, CENER, Biomass Energy Dpt., Sarriguren, SPAIN**

Presenter's biography:

Ms Inés del Campo has a Msc in Chemical Engineer. Since 2002 she has been working in CENER Biomass Department as a Biomass Senior Researcher in Biomass Evaluation and Assessment and Biofuel Production projects. She worked before in CIEMAT Liquid Biofuels Group.

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Session reference: 3BV.5.12

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Syngas Fermentation - A Biotechnological Way to Utilize Synthesis Gas

Short introductive summary:

The purpose of this work is to present the opportunities and challenges of synthesis gas fermentation, a biotechnological process in which gas mixtures of H<sub>2</sub>, CO and CO<sub>2</sub> are converted to fuels and chemicals. An overview of the developments and advancements in research will be given.

Fermentation of synthesis gas with anaerobic bacteria acting as a biocatalyst is an attractive process for the production of fuels and chemicals. Possible substrate sources are reformed biogas or gasification of wastes, residues from agriculture and forestry. An alternative new approach for gas supply is water and/or CO<sub>2</sub> electrolysis, using overload renewable electricity. A known bottleneck in gas fermentation is gas-liquid mass transfer of low soluble gas components like H<sub>2</sub> and CO. To increase fermentation efficiency, different approaches are currently under investigation. These include for example reactor design issues with regard to mass transfer enhancement, as well as research activities in the area of genetic engineering.

Presenter: **Ina Katharina STOLL, Karlsruhe Institute of Technology, IKFT Dpt., Eggenstein-Leopoldshafen, GERMANY**

Presenter's biography:

Bachelor of Science 2013

Master of Science 2016

Chemical Engineering

Karlsruhe Institute of Technology

since October 2016

PhD student at KIT

Institute of Catalysis Research and Technology

Investigation of the fermentation of synthesis gas at elevated pressure

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Session reference: 3BV.5.16

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



**A Review on the Biorefinery Options under Research in Europe: Market Study of Potential Products, Technology TRLs and Research Infrastructures**

Short introductive summary:

Within the project BRISK2 (funded by Horizon 2020, Grant Agreement Number 731101), different pathways are explored towards the conversion of multiple feedstock types into valuable products that can replace materials and energy from fossil refineries. When taken as a unity, the links can be combined in a variety of cascade processes, capable of supplying a wide range of energy vectors and high-added value chemicals. In more detail, several biogenic feedstock classes (i.e., lignocellulosic biomass, agricultural wastes, municipal and industrial wastes, algae biomass, residues) are linked with bioproducts (such as, methanol, ethanol, butanol, hydrocarbons, oils, dimethyl-ether) via two major pathways, based on thermal and biological conversion technologies. It is anticipated that the development of BRISK2-biorefineries will lead to the full exploitation of biomass, higher conversion efficiencies, new technologies and co-products. As a result, opportunities will inevitably arise for the European bio-economy, by giving access in existing and opening new markets for advanced biorefinery products.

**Presenter:** **Kyriakos PANOPOULOS, Centre for Research & Technology Hellas, Chemical Process & Energy Resources Institute, Thessaloniki, GREECE**

Presenter's biography:

Dr. Kyriakos D. Panopoulos is currently a researcher Centre for Research and Technology Hellas/ Chemical Process and Energy Resources Institut. He currently leads a research group on the fields of gasification and biofuel production.

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Session reference: 3BV.5.19

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## An Environmental Assessment of Biorefining of Rubber Dandelion to Rubber and Bioplastic

Short introductive summary:

DRIVE4EU - 'Dandelion Rubber and Inulin Valorization and Exploitation for Europe' aims at the development and demonstration of the production chain of natural rubber and inulin from Rubber dandelions (*Taraxacum koksaghyz*, TKS). Within the project an environmental assessment using the methodology of Life Cycle Assessment (LCA) is performed. The aim is to identify, quantify and assess the most important environmental impacts and benefits of rubber and inulin from Rubber dandelion based on the whole value chain. Within the LCA different cases are modelled by defining the system boundaries, the DRIVE4EU production chain and relevant reference systems, providing the same main products and co-products and using the same area of land as the Rubber dandelion system. The LCA within DRIVE4EU provides information about the environmental sustainability of the DRIVE4EU process chain (natural rubber and bioplastic produced from inulin) in comparison to the substituted reference system (natural rubber from rubber trees and plastic from fossil resources).

Presenter: **Gerfried JUNGMEIER, Joanneum Research Centre, Research Centre for Climate, Energy and Environment, Graz, AUSTRIA**

Presenter's biography:

Highlights of professional experiences:

- life cycle assessment of bioenergy for transport, electricity, heat and biorefineries
- greenhouse gas assessment of products and services
- sustainability assessment and future scenarios for transportation fuels of the future iV biofuels, e-mobility and hydrogen
- Austrian Representative in activities of the International Energy Agency (IEA) on "Bioenergy", "Hybrid and Electric Vehicle (HEV)" and "Alternative Motor Fuels (AMF)"

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Session reference: 3BV.5.20

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Process Design, Simulation and Technoeconomical Assessment of a Biorefinery Utilizing Saccharina Japonica Macroalgae**

Short introductive summary:

This study show the process design concept and techno-economical assessment of an industrial scale brown seaweed based bio-refinery, which utilizes both bio-conversion and thermal conversion pathways.

Presenter: **Boris BRIGLJEVIC, Pukyong National University, Chemical Engineering department, Busan, REPUBLIC OF KOREA**

Presenter's biography:

Senior researcher and PhD candidate in chemical engineering with a focus on bio-refinery process design and simulation at (March 2015-August 2018 expected). MSc in Materials for Sustainable and Renewable Energies, Heriot-Watt University, Edinburgh, UK.

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Session reference: 3BV.5.21

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Biochar Application on the Energy Grass Giant Reed: Yield and Nitrogen Uptake

Short introductive summary:

Several studies indicated that biochar generally exerts positive impact on soil water retention, biomass yield, and carbon sequestration. Whilst the effect of biochar was investigated in many crops, no studies are available in the literature regarding biochar application on the energy grass giant reed (*Arundo donax* L.). Since giant reed demonstrated inherent ability in accruing soil carbon stock, up to deep soil layers, the disposal of biochar has the potential to strengthen the soil carbon sequestration of this energy crop. However, the effect of biochar on yield and nitrogen uptake of this species is not well understood. Therefore, our study fills a gap knowledge on this promising energy grass.

Presenter: **Enrico CEOTTO, CREA- Council for Agricultural Research and Economics, Research Centre for Agriculture and Environment, Bologna, ITALY**

Presenter's biography:

Enrico Ceotto is Senior Researcher Agronomist at the Research Center Agriculture and Environment, located in Bologna, Northern Italy. Currently, his research activity is focused on perennial energy crops and their ecosystem services. E-mail address: [enrico.ceotto@crea.gov.it](mailto:enrico.ceotto@crea.gov.it).

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Session reference: 4BV.6.1

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

**Environmental Impacts and Economic Performance of Major Oil Crops in Italy**

Short introductive summary:

The promotion of the use of biofuels for transport is one of the main objectives of the European Union (EU) energy policy of recent years, in order to reduce greenhouse gas (GHG) emissions, diversify fuel supply sources, and decrease dependency on fossil fuels. Vegetable oil is the main raw material used to produce biodiesel. Sunflower and rapeseed are the most important oil crops cultivated in Italy, and their areas are expected to grow over the next years. Over the whole biodiesel supply chain, the cultivation represent the highest negative environmental impact both for sunflower and rapeseed. Besides considering the environmental impact, crop production should also be assessed from an economic perspective. Eco-efficiency is a measure of sustainability that directly links environmental impact with economic performance. This study aims to assess both the environmental performance of sunflower and oilseed rape using the Life Cycle Assessment method, and their economic return using the eco-efficiency method, identifying what is necessary to jointly minimize their environmental impact and maximize their economic value.

Presenter: **Alessandro SUARDI, CREA- Council for Agricultural Research and Economics, Centro di ricerca Ingegneria e Trasformazioni Agroalimentari, Monterotondo RM, ITALY**

Presenter's biography:

Temporary Research Associate at CREA-ING

Field of research:

- Agricultural mechanization
- Energy crops
- Life Cycle Assessment

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Session reference: 4BV.6.2

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Impact of Wood Pellet Demand on Biodiversity in the Southeastern US

Short introductive summary:

Increasing use of pulp wood trees for wood pellet production and subsequent land use changes are expected to impact biodiversity in the southeastern US. A spatially explicit analysis identified hotspots of potential impacts on total, threatened and endemic species richness through the combination of species habitat data and land use projections under different pellet demand scenarios up to 2030. Both positive and negative impacts of increasing wood pellet demand on species richness were expected to be most pronounced in coastal parts of Alabama, Mississippi and South Carolina, due to expansion of pine plantation area and regeneration of natural forest.

Presenter: **Anna DUDEN, Utrecht University, Copernicus Institute of Sustainable Development, Utrecht, THE NETHERLANDS**

Presenter's biography:

Anna Duden is a PhD student at the Copernicus Institute, Utrecht University, studying the environmental impacts of bioenergy.

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Session reference: 4BV.6.3

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Life Cycle Assessment (LCA) of the Thermochemical Conversion of Biomass for the Production of Fuel, Electricity and Heat**

Short introductive summary:

In order to reduce greenhouse gas emissions and fossil fuel consumption, biomass is increasingly considered as raw material for alternative fuel production. While 1st generation biofuels compete with food production for resources and arable land, 2nd generation biofuels, based on lignocellulosic biomass residues, avoid this competition. In this paper, the thermochemical conversion of cereal straw to fuel, electricity and heat (Bioliq® process chain) is analysed from an ecological point of view.

Presenter: **Martina HAASE, KIT, ITAS, KARLSRUHE, GERMANY**

Presenter's biography:

Dr. Martina Haase has a University degree in environmental sciences and a doctoral degree in economics. As scientific staff at KIT she has worked on several projects concerning the assessment of sustainable biomass potentials as well as on the assessment of process chains for biomass utilization.

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Session reference: 4BV.6.6

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **An Expert Knowledge Approach for Designing Sustainable Forest Biomass Supply Chains**

Short introductive summary:

In the context of energy transition and climate change mitigation, using forest biomass for bioenergy purposes has been increased in the last decade. However the growing demand for bioenergy will require production of large quantities of forest biomass which will increase pressure on this resource and affect its sustainability.

The aim of this work is to avert this issue by identifying key criteria and best planning indicators that can be used to assess the ecological sustainability of biomass harvesting activities, using DELPHI method, as an experimental tool for decision making.

The Delphi method is adopted to find a consensus between selected experts using a series of questionnaires delivered by multiple iterations, on the environmental impacts of biomass procurement on different types of ecosystems, on sustainability indicators and on how to operationalize them.

Indicators and best practices that will have emerged from the Delphi will be mapped and applied in order to identify environmentally sustainable biomass procurement areas and feedstock availability

Presenter: **Ichrak LAKHDHAR, University Laval, Wood Science and Forestry, Québec, CANADA**

Presenter's biography:

2017: Postdoctoral fellow, university Laval, Quebec, Canada

2016: PhD. Eng in sciences and engineering of lignocellulosic materials, University of Quebec at Trois-Rivieres, Canada

2011: Master degree in mechanics and fibers science, ENSISA engineering school, France

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Session reference: 4BV.6.7

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY



## **The Impacts of Large-Scale Bioenergy on Global Spatial Patterns of Land Use Change and Climate over the Next Century**

Short introductory summary:

Charlotte is in her second year of studying for an interdisciplinary MSc/PhD in the Doctoral Training Centre for Bioenergy at The University of Leeds in the UK. Her research looks at the impacts of large scale bioenergy production, and thus crop cultivation, on land use change over the next 100 years and the corresponding impacts this could have on climate. This has been carried out by analysing spatially-explicit scenarios that apply different policies of land use change from incorporating bioenergy into the energy mix. These scenarios have been inputted into the University of Victoria's UVic Earth System climate model to determine their global biogeophysical and biogeochemical effects on climate.

Presenter: **Charlotte WEAVER, Leeds, UNITED KINGDOM**

Presenter's biography:

I am studying for an interdisciplinary MSc/PhD in the Doctoral Training Centre for Bioenergy. My research area looks at the impacts of large scale bioenergy production, and thus crop cultivation, on land use change over the next 100 years and the corresponding impacts this could have on climate.

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Session reference: 4BV.6.10

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Exploring the Potential Biomass Trade from North America to Northern Europe and Subsequent Environmental Consequences**

Short introductive summary:

Biomass has been one of the major renewable energy sources. However, recently it has been increasingly scrutinized in policy level in Europe. The scrutiny may cause significant change in bioenergy sector. The change in policy may turn the focus to value-added products such as chemicals and transport fuel rather than just heat and electricity. As a result of this, the heat and energy sector in Finland may find themselves short of raw material and may need to look outside of Europe. In this study, authors will attempt to explore the bioenergy market outside Europe.

Presenter: **Raghu KC, Lappeenranta University of Technology, Laboratory of Bioenergy, Mikkeli, FINLAND**

Presenter's biography:

Raghu KC is a junior researcher at the Lappeenranta University of Technology, Bioenergy laboratory unit located in Mikkeli, Finland. The theme of his research is mainly focused on sustainability study of biomass based energy.

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Session reference: 4BV.6.11

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Life Cycle Assessment of Bioenergy Systems: the Lack of Consistency Checks at the Roots of Divisive Results

Short introductive summary:

This work aims at assessing the consistency and robustness of some influential bioenergy LCA studies which have fuelled the debate on bioenergy sustainability. The scope is to reconcile the bioenergy-sceptics and the bioenergy-enthusiasts around the need of a shared understanding of the environmental impacts of bioenergy so that conflicting knowledge claims are avoided and the message from science to policy makers becomes less scattered, or at least more transparent.

The work is organised as a reasoned and parametrised review. We have identified and collected a non-exhaustive number of bioenergy LCA studies and reviewed them with the scope of assessing their methodological approach. The purpose is to provide practitioners and academics a reasoned and critical collection of the most likely methodological flaws in LCA studies of bioenergy so that they can easily be spotted and avoided in future works. A follow up work will capitalize on the findings of this review and will present recommendations and lessons learned from the use of LCA for policy support in bioenergy policies.

Presenter: **Alessandro AGOSTINI, ENEA Research Centre, DTE-BBC-BBE, Rome, ITALY**

Presenter's biography:

Alessandro Agostini is an environmental scientist, researcher at ENEA. His main activity is the environmental impact assessment of bioenergy, with a life cycle approach, with a focus on GHG emissions from solid and gaseous biofuels.

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Session reference: 4BV.6.14

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

**Life Cycle Assessment of Hydrogen Production from Biorefinery Residues**

Short introductive summary:

Gasification of biomass can be used for obtaining hydrogen reducing the total greenhouse gases emissions due the fixation of CO<sub>2</sub> during photosynthetic processes. The kind of raw materials is an important variable since has a great influence on the energy balance and environmental impacts. The hydrolytic lignin residue is considered as the most appropriate raw materials since they do not compete for land. Moreover, it is a byproduct of second-generation ethanol production and can be exploited for producing additional chemicals, power, combined heat and power. Indeed, the optimal use of this residue is a key factor for the economic and environmental sustainability of a biorefinery, not only disposal costs can be avoided but additional incomes can be provided.

The aim of this work is to evaluate the environmental potentials impacts of the production of hydrogen through gasification of this residue and to identify the hotspot. An LCA study has been developed for a 200 kWth gasification pilot plant using experimental data.

Presenter: **Nadia CERONE, ENEA Research Centre, Technical Unit for Trisaia Technologies, Rotondella, ITALY**

Presenter's biography:

Senior researcher at ENEA in development of technologies and processes of energy exploitation of biomass for electricity and biofuels. Expert of pyrolysis and gasification plants; hydrogen separation, LCA and project management.

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Session reference: 4BV.6.15

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Biodiversity, Ecosystem Services and Bioenergy: a Systematic Review on the Effects of Bioenergy Production on Relevant Ecosystems**

Short introductive summary:

The Millennium Ecosystem Assessment recognizes the importance of Ecosystem Services (ES) for human well-being. Recent studies have proved the key-role of biodiversity in maintaining ecosystem functions that underpin the provision of ES and the strong linkages existing between biodiversity attributes (i.e. species richness,) and Ecosystem Services.

Biodiversity loss is one of the main environmental challenges facing the planet.

In the past years the debate on bioenergy sustainability has focused mainly on assessing bioenergy's potential for climate change mitigation, seriously under researching other impacts that bioenergy expansion may have on the ecosystems related to bioenergy production.

With this work we aim at filling the gap in the environmental impact assessment of bioenergy to go beyond the usual climate change-effects analysis, by integrating biodiversity loss and Ecosystem Service provision into bioenergy Life Cycle Assessment(LCA).

Presenter: **Claudia BULGHERONI, European Commission, JRC, Directorate C - Energy, Transport & Climate, Ispra, ITALY**

Presenter's biography:

Scientific officer at the Joint Research Centre of European Commission. Agronomist, PhD in Innovation Technology for Agricultural and Agro-Environmental Sciences. Currently involved in research activities on environmental impact assessment of advanced biofuels, using Life Cycle Assessment.

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Session reference: 4BV.6.16

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

**Camelina and Crambe vs. Tropical Oil Crops: What Are the Environmental Benefits?**

Short introductive summary:

Today, the European oleochemical industry depends on imported tropical plant oils (such as palm kernel and coconut oil) and fatty acids as sources for medium-chain fatty acids and polymer building blocks. The EU-funded COSMOS project aims at reducing this dependence by establishing camelina (*Camelina sativa* (L.) CRANTZ) and crambe (*Crambe abyssinica* HOCHST. ex R.E.FR.) as novel European oil crops. Both of them are particularly suited for this purpose due to their fatty acid composition and other favourable characteristics.

As part of the comprehensive integrated life cycle sustainability assessment within COSMOS, we have conducted a first analysis of environmental impacts by means of life cycle assessment (LCA) and life cycle environmental impact assessment (LC-EIA).

Selected interim results will be presented showing that i) camelina and crambe are performing similar to rapeseed, ii) there is an enormous potential to reduce GHG emissions related to land use changes by replacing tropical plant oils and iii) the land footprint is dependent on co-product use options and accounting. The detailed presentation of interim results will be complemented by conclusions and recommendations.

Presenter: **Guido REINHARDT, IFEU-Institut Heidelberg, Biomass & Food, Heidelberg, GERMANY**

Presenter's biography:

Dr. Guido Reinhardt is a member of the scientific board of IFEU-Institute for Energy and Environmental Research Heidelberg and a scientific director of the department "Sustainability of renewable energies and bio-based systems" with more than 25 years of professional experience in this topic.

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Session reference: 4BV.6.17

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **How to Meet Challenges of Emission Control for Biomass Combustion in Small and Medium Scale Applications in Germany**

Short introductive summary:

This paper gives an overview of recent R&D-measures in Germany to satisfy new strict EU-and national requirements for emission control at small and medium scale combustion plants (SMSCP) with biofuels. The presentation highlights the strategy of the R&D-support for emission control in Germany.

Presenter: **Wibke BAUMGARTEN, FNR - Agency for Renewable Resources, EU/International Affairs, Gülzow-Prüzen, GERMANY**

Presenter's biography:

since 10/2017 Senior advisor at FNR

since 01/2016 Project coordinator at FNR

since 11/2014 Lecturer (PD) in Soil Science, Rostock University, Germany

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2006 PhD in Soil Science, CAU Kiel, Germany

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Session reference: 4BV.6.19

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Study of the Potential Ecological Risk of Heavy Metals in the Residue from Thermal Conversion of a Sewage Sludge**

Short introductive summary:

The thermal conversion of the sewage sludge by pyrolysis, gasification and combustion can be an attractive alternative because it reduces the volume of the residue and improve its properties for safe disposal. However, the high content of some heavy metals in sewage sludge has to be carefully considered to come up with rational and sustainable disposal methods. Therefore, the study of the heavy metals distribution in the final residue after the thermal conversion of the sewage sludge is a key topic in order to implement clean methods to valorize sewage sludge.

Presenter: **Pedro HARO, Universidad de Sevilla, Chemical and Environmental Engineering, Seville, SPAIN**

Presenter's biography:

Pedro Haro is a post-doc researcher at the Bioenergy Group since 2015. His main research topic is the design and assessment of thermochemical biorefineries and waste-energy systems. He has collaborated with several research centers for the evaluation of pre-commercial and demonstration projects.

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Session reference: 4BV.6.23

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY



**Anaerobic Immobilized Biological Method for Wastewater Management**

Short introductive summary:

Anaerobic biological treatment of wastewater not only produces methane during treatment but also expends less energy and produces less waste sludge doing so in comparison to aerobic biological methods. However, issues of slow growth rates of anaerobic microorganisms, long hydraulic retention time, and wash-out of biomass are often encountered when using anaerobic processes for treatment of low-strength domestic wastewaters. These issues have been significantly overcome in this work by an immobilized biological method (IBM) involving entrapped mixed microbial cells, in which the concentration of biomass and sludge retention have been increased while the hydraulic retention time has been reduced during anaerobic treatment of low-strength domestic wastewater.

The anaerobic IBM device enabled very high biomass via the bio-plates that increased the tolerance of the biomass to temperature shock or speeded up its recovery from shock, presenting a unique configuration among contemporary anaerobic reactors that achieve stable treatment performance for low-strength wastewaters at a short contact time and low temperature.

Presenter: **Cheng-Fang LIN, National Taiwan University, Graduate Institute of Environmental Engr, Taipei, TAIWAN**

Presenter's biography:

Director and professor, Graduate Institute of Environmental Engineering, National Taiwan University

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Session reference: 1BO.13.1

Subtopic: 1.5 Municipal and industrial wastes

Topic: 1. BIOMASS RESOURCES

## The Valorization of the Organic Fraction of Municipal Solid Waste in a Biorefinery Concept

Short introductive summary:

The pretreatments of the organic fraction of municipal solid waste (OFMSW) for the anaerobic digestion (AD) process are designed to address the limitations of substrate degradation related to the nature and composition of the raw material. In this view, they usually contribute to improve the AD process performances, enhancing the biomass conversion into both energy carriers and digestate. More recently, some studies have pointed out the possible use of OFMSW for the recovery of other bio-based products, which may have a high commercial value in the market, as Volatile Fatty Acid or lignin.

The main purpose of this research is in the study of the applicability of an organic solvent pretreatment to the OFMSW as a source of potential value-added chemicals. Differently composed organic samples were treated by formic acid under various operating conditions. Chemical-physical characteristics, biodegradability and structural changes of the substrates were investigated to evaluate the pretreatment effects. The preliminary results highlight the effectiveness of the organic solvent pretreatment, which raises as an alternative process for the greatest valorization of organic solid waste.

Presenter: **Anna CONTE, University of Salerno, Civil Engineering Department, Salerno, ITALY**

Presenter's biography:

I obtained in 2014 the a MSc degree with honors in Civil and Environmental Engineering at the University of Salerno. Since November 2015, I am a PhD student at Doctoral School of Civil and Environmental Engineering of the University of Salerno.

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Session reference: 1BO.13.2

Subtopic: 1.5 Municipal and industrial wastes

Topic: 1. BIOMASS RESOURCES

**Polyhydroxyalkanoates (Pha) Production from Urban Biowaste Mixture at Pilot Scale**

Short introductive summary:

The aim of the work is to give a practical example of a possible integration of organic waste management and wastewater treatment through a multi-step process for biowaste conversion into biopolymer, more specifically Polyhydroxyalkanoates (PHA). PHA are considered one of the most promising biopolymers to replace part of the synthetic materials. Unfortunately the high production cost, due to the utilization of pure cultures and refined media as substrate, strongly limited the PHA market viability. However, many evidences of the effective use of waste organic feedstock are reported in the literature with yields comparable than those obtained by pure substrates; and besides the use of biowaste, the development of cost-effective fermentation strategies is decisive for the economic feasibility of microbial PHA production processes.

Presenter: **Paolo PAVAN, University Cà Foscari of Venice, Environmental Sciences Dpt., Mestre, ITALY**

Presenter's biography:

Graduate in Industrial Chemistry in 1989, now full professor at University Ca Foscari of Venice, main research fields focuses on waste and wastewater treatment, circular economy, energy production from biomasses, chemical synthesis using mixed cultures. Author of more than 250 publications

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Session reference: 1BO.13.3

Subtopic: 1.5 Municipal and industrial wastes

Topic: 1. BIOMASS RESOURCES

## **A Comparative Analysis of Biowaste Management in Five European Clusters**

Short introductive summary:

This study compares the current management of urban biowaste in five European clusters. The ultimate goal is to address the technical feasibility of a urban biorefinery concept for the production of bio-plastic from urban biowaste.

Presenter: **Alessio BOLDRIN, Technical University of Denmark, Environmental Engineering, Kgs. Lyngby, DENMARK**

Presenter's biography:

Alessio Boldrin is Senior Researcher in the field of waste and resource management at the Department of Environmental Engineering, Technical University of Denmark. He has a M.Sc. in Environmental Engineering (DTU, 2005) and holds a Ph.D. in Waste Management (DTU, 2009).

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Session reference: 1BO.13.4

Subtopic: 1.5 Municipal and industrial wastes

Topic: 1. BIOMASS RESOURCES

**Process Design and Preliminary Lca of Butanol and Hydrogen Production from Autoclaved Municipal Solid Waste Feedstock**

Short introductive summary:

In 2015/2016, the total municipal solid waste (MSW) collected by local authority in the U.K. is 26 million tonnes. The EU's effort to the full implementation of circular economy principles is an important driving force towards effective recovery of resources (materials and energy) from organic content of municipal solid wastes.

MSWBH is a BESTF2-funded demonstration project to produce at scale Butanol and Hydrogen from MSW, establishing MSW autoclaving as a viable pre-treatment technology of MSW's biomass content. The study describes in detail acetone, butanol, ethanol (ABE) and hydrogen production from autoclaved municipal solid waste feedstock with various waste composition design. Preliminary LCA analysis using the mass and energy balance data is undertaken to compare among MSWBH process, energy recovery, and options for treating the non-biogenic component of waste. Excluding the disposal of non-biogenic content of MSW, the ABE production from MSW shows a net primary energy demand of -341 MJ/t MSW and net greenhouse gas emission of -6.5 kg CO<sub>2</sub>eq/t MSW mainly due to the energy recovery from lignin, biogas from waste water treatment and sludge.

Presenter: **Fanran MENG, University of Nottingham, Department of Mechanical, Materials and Manufacturing Engineering, Nottingham, UNITED KINGDOM**

Presenter's biography:

Fanran Meng is a Research Fellow in the Faculty of Engineering since 2017. His current research focuses on life cycle environmental sustainability of waste valorisation opportunities, with specific focus on carbon fibre composite materials and municipal solid waste.

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Session reference: 1BO.13.5

Subtopic: 1.5 Municipal and industrial wastes

Topic: 1. BIOMASS RESOURCES

## **The Effect of Biomass Drying on the Overall Efficiency and Economics of Combined Production of Transportation Fuels And Heat by Steam Gasification and FT-Synthesis**

Short introductive summary:

Biomass gasification combined with Fischer-Tropsch synthesis is recognized as an attractive option for producing liquid transportation fuels from renewable feedstocks. In the attempt to accelerate the penetration of sustainably produced biofuels in the fuel market, VTT is currently developing a BTL concept that has relatively low investment costs (200-300 M€) and is suited for intermediate scale (100-150 MW fuel input) corresponding to 30-50 ktoe/a production of transportation liquids. The proposed concept combines a steam-blown dual fluidised-bed gasifier operated at close to atmospheric pressure with a simplified gas clean-up train. In this process, biomass drying plays a key role in maximizing the overall energy efficiency as well as the yield of the main product, FT-liquids. This paper summarizes the main findings of the detailed techno-economic studies on the heat integration of the process. Two drying technologies and two final moisture contents were included in this comparison. Results from pilot scale steam drying tests carried out with forest residues and crushed willow are also discussed.

Presenter: **Sanna TUOMI, VTT, FINLAND**

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Session reference: 2BO.14.1

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Ultrapure Hydrogen from Biomass Syngas by Pd/Ag Membrane Reactor

Short introductive summary:

At present, 96% of the world hydrogen production is directly produced from fossil fuels and about 4% is produced indirectly by using electricity generated through them. Because of the envisaged role of hydrogen as energy carrier and basic chemical in the future decarbonized society, it is necessary to find renewable sources for the supply. The syngas produced from a biomass gasification contains about 20- 50% of H<sub>2</sub> and 20-30% of CO that can be converted by Water Gas Shift (WGS) to CO<sub>2</sub> producing more hydrogen.

The aim of this work was to perform the WGS reaction in a catalytic Membrane Reactor (MR) starting from a syngas having the typical composition obtained in gasification tests of lignocellulosic biomass with air/oxygen/steam when carried out in a pilot plant of nominal input 200kWth.

Presenter: **Nadia CERONE, ENEA Research Centre, Technical Unit for Trisaia Technologies, Rotondella, ITALY**

Presenter's biography:

Senior researcher at ENEA in development of technologies and processes of energy exploitation of biomass for electricity and biofuels. Expert of pyrolysis and gasification plants; hydrogen separation, LCA and project management.

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Session reference: 2BO.14.2

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## The Oxidation of Ethylene Glycol - A Pyrolysis Oil Surrogate

Short introductive summary:

The submitted work focused on developing a reduced reaction mechanism for ethylene glycol, a pyrolysis oil surrogate. The reduced mechanism is based on a detailed ethylene glycol mechanism developed at German Aerospace Center (DLR) Stuttgart. The aim of the reduced mechanism is to model the chemistry of ethylene glycol oxidation in Computational Fluid Dynamics (CFD) simulations of entrained flow gasification process. Reduced mechanism is validated by comparing experimental data for ignition delay times and laminar flame speeds of ethylene glycol and subspecies with calculations performed using reduced mechanism. Good agreement is observed between experiment and simulations. The reduced mechanism will be used in Euler-Euler CFD simulations of entrained flow gasification process.

Presenter: **Niranjan FERNANDO, German Aerospace Center (DLR), Chemical Kinetics, Stuttgart, GERMANY**

Presenter's biography:

Bachelor degree in Chemical and Process Engineering, University of Moratuwa, Sri Lanka. (2008-2013)

Master degree in Chemical and Process Engineering, University of Moratuwa, Sri Lanka. (2014-2015)

Presently a PhD candidate in German Aerospace Center (DLR) Stuttgart.

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Session reference: 2BO.14.3

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



**Analysis of Syngas Production via Sorption Enhanced Chemical Looping Biomass Gasification**

Short introductive summary:

In this study, a detailed thermodynamic analysis of the sorption enhanced chemical looping biomass gasification (SE-CL-BG) using CaO as CO<sub>2</sub> sorbent and NiO as oxygen carrier was conducted. The effect of different parameters such as reaction temperature, reaction pressure, CaO/biomass ratio and CaO/NiO ratio are investigated. Moreover, the effect of various gasification agents such as air, steam, and CO<sub>2</sub> taken from calcination reactor on SE-CL-BG was specifically addressed. The preliminary results of thermodynamic analysis showed that the presence of CaO sorbent in the fuel reactor leads to higher H<sub>2</sub> yield and lower CO yield as compared with the traditional biomass gasification (BG) and chemical looping biomass gasification (CL-BG). The CO<sub>2</sub> sorbent lost its CO<sub>2</sub> capture capability when temperature is higher than 750°C. It was also shown that the performance of BG and CL-BG has no significant difference.

Presenter: **Reiyu CHEIN, Taichung city, TAIWAN**

Presenter's biography:

currently serve as a full professor at the dept. of mechanical engineering, National Chung Hsing University, Taiwan.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 2BO.14.4

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Residual Char from Gasification Integrated in a Tar Removal System**

Short introductive summary:

The Low Temperature-Circulating Fluidized Bed (LT-CFB) gasifier is a staged process, designed for the conversion of cereal straw and other ash-rich feedstocks. The drawback of this technology is the severe tar load and the high particulate content in the producer gas: it is necessary to implement a feasible gas cleaning step to upgrade the gas for downstream applications. The solution proposed in this work is the use of a separate reactor, which uses residual gasification char. The tested char is the by-product of the 100kWth TwoStage gasifier (Viking) at DTU, Risø Campus: this material has interesting properties, comparable to commercial activated carbon. A test reactor has been built with the aim of testing the effect of a hot char bed (800°C), with or without coupling with a partial oxidation zone. The reactor was connected to the main outlet pipe of the 100kWth LT-CFB gasifier at DTU, Risø. The quality of the producer gas has been assessed in detail before and after the cleaning step. Results are expected to demonstrate the feasibility of this solution for improving the quality of the LT-CFB producer gas by using gasification residual char.

Presenter: **Giulia RAVENNI, Technical University of Denmark, Chemical Engineering Dpt., Roskilde, DENMARK**

Presenter's biography:

Giulia obtained her Master in Energy Engineering at the University of Florence, Italy. Since October 2015, she works as a PhD student at the Technical University of Denmark (DTU).

Her project focuses on the use of residual char for tar removal in biomass gasification.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 2BO.14.5

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Building the Perfect Beast: Designing Alternative Fuel Policy to Work

Short introductive summary:

Despite a wide variety of policies being put in place to accelerate the deployment of advanced alternative fuel technologies, it is generally accepted that rate of commercialisation of advanced biofuels and other advanced alternative fuels has been disappointing, with government targets for volumes of advanced alternative fuel supply being repeatedly missed. In this paper, it is argued that one reason for this failure to achieve commercialisation is that the policy tools used have been fundamentally ill-suited to the challenge of delivering investment in technologies that are capital intensive but have not yet been successfully demonstrated at commercial scale. An alternative policy structure, referred to as an 'Advanced Alternative Fuel Support Obligation' (AAFSO), that is designed specifically to deliver enhanced value confidence to investors, to handle the dual risks to policy stability from over-supply and under-supply of fuels, and to manage the overall cost to society of technology commercialisation. It is argued that by improving the predictability of policy value to investors, such a policy could deliver better outcomes at lower cost than existing policy tools.

Presenter: **Chris MALINS, Cerology - Ideas for a sustainable future, London, UNITED KINGDOM**

Presenter's biography:

Chris is the founder of Cerology, an independent consultancy specialising in policy and sustainability issues around alternative liquid fuels and petroleum production. Before founding Cerology, Chris led the fuels team of the ICCT for six years, and prior to that led communications for the UK RFA.

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Session reference: 4BO.15.1

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## EU Bioenergy Policy: a Wicked Problem?

Short introductive summary:

The term 'wicked problems' describes problems of public policy which are influenced by many dynamic social and political factors as well as biophysical complexities. Wicked problems are characterized by "Uncertainty over consequences, diverse and multiple engaged interests, conflicting knowledge claims and high stakes".

In the years following the publication of the EU Renewable Energy Directive (RED), an intense debate has spread across various levels of society, around the environmental sustainability of biofuels and bioenergy.

With this work we start to analyse the debate surrounding EU bioenergy policy as a complex interaction of scientific, public policy and social drivers and we show that it indeed presents many characteristics of wicked problems. As such, any solution adopted cannot be classified as "good" or "bad", "right" or "wrong" but it will have to emerge as a political compromise among stakeholders, including scientists. In this framework, we also take the chance to highlight the tools employed by the European Commission in the Proposal for a Recast of the Renewable Energy Directive, to tackle this wicked problem.

Presenter: **Alessandro AGOSTINI, ENEA Research Centre, DTE-BBC-BBE, Rome, ITALY**

Presenter's biography:

Alessandro Agostini is an environmental scientist, researcher at ENEA. His main activity is the environmental impact assessment of bioenergy, with a life cycle approach, with a focus on GHG emissions from solid and gaseous biofuels.

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Session reference: 4BO.15.2

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

**Are New Policies Really Needed to Exploit Marginal Land in the EU? The Case of Biochar in Dry EU Med Areas**

Short introductive summary:

Dry conditions and thus desertification – in all its different forms – in the Mediterranean area is rapidly proceeding, representing a major risk for the environment and agriculture, bringing also huge socio-economic impacts. The rate desertification is occurring is well documents, and EU/International institutions provide detailed description and GIS maps with most critical areas. Spain, Greece, Italy and Portugal are the most affected regions, but also the non-EU Southern rim of the MED basin is under similar or even worst conditions. We investigated the possibility of combining different EU policies that are already in place (with only minor adaptations), and analyze if a combined action would allow for achieving economic sustainability and thus commercial deployment of biochar and compost in agriculture, favouring decentralized production of biochar. The actual question we intended to address was, in fact, the following: do we really need to elaborate new policies to target EU MED marginal land and its sustainability/Resilience, or should we rather implement (in case, adapt) existing ones?

Presenter: **David CHIARAMONTI, RE-CORD and Department of Industrial Engineering, University of Florence, Industrial Engineering Dpt., FIRENZE, ITALY**

Presenter's biography:

David Chiaramonti teaches Bioenergy Conversion Technologies at the University of Florence, where he carries out research on thermochemical biomass conversion at CREAR. He chairs the Renewable Energy COnsortium for R&D of the University of Florence.

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Session reference: 4BO.15.3

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Modelling Least-Cost Deployment of Biofuels for Achieving Climate Targets in Germany under the Renewable Energy Directive II-Proposal**

Short introductive summary:

Biofuels are an option to achieve GHG reductions in the transport sector, with numerous possible competing production pathways, all paired with trade-offs and future uncertainties. Land use, feedstock cost, conversion efficiencies, technological learning, investments costs and GHG-abatement are but few of the important factors to consider for a biofuel policy. With the proposal for Renewable Energy Directive (RED) II, which will decide EU policy on biofuels between 2021 -2030, some changes are made to the previous RED. This time, focus will be more on advanced fuels, mainly from residual biomass but also electrofuels (PtG/PtL). In this work, the competitiveness of all relevant options for achieving greenhouse gas (GHG) abatement targets under the given restrictions is assessed.

Presenter: **Daniela THRÄN, DBFZ-German Biomass Research Centre, Bioenergy Systems Dpt., Leipzig, GERMANY**

Presenter's biography:

Head of Department "Bioenergy Systems" at DBFZ and "Bioenergy" at UFZ. About 50 scientists work in those departments. Since the end of 2011 holding the chair „Bioenergy Systems“ at the University of Leipzig. Member of the German Bioeconomy Council and the European Bioeconomy Stakeholder Panel.

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Session reference: 4BO.15.4

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## The Role of Industrial Biorefineries in a Low-Carbon Economy

Short introductive summary:

IEA Bioenergy and IEA IETS are international collaborations with the goal to accelerate the deployment of bioenergy and energy saving in industry. This paper will show opportunities of biorefineries in different sectors and present recommendations for research, industry and policy, based on a joint workshop.

Presenter: **Kees KWANT, Netherlands Enterprise Agency, Ministry of Economic Affairs, RVO, Utrecht, THE NETHERLANDS**

Presenter's biography:

Kees W. Kwant has a background in Fluid Dynamics and Technology Development from the Technical University Twente.

He worked at industry DSM to develop fermentation processes and was programme manager of the national solar energy programme of the Netherlands.

He has extensive experience in developing and implementation of bioenergy in the Netherlands and abroad, develop sustainability and chaired the working group on the GHG calculation methodology. At present he is Liaison Biobased Economy and the linking pin between research and implementation in the framework of the Biobased and Renewable Energy Programs of RVO in the Netherlands. He participates in the EU programs: [www.biomasspolicies.eu](http://www.biomasspolicies.eu) and Bioenergy for Business. He holds the Chair of the IEA Bioenergy Implementing Agreement and is Executive member and for the Netherlands [www.ieabioenergy.com](http://www.ieabioenergy.com) Winner of the Dutch Bioenergy price 2009 of the Platform Bioenergy.

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Session reference: 4BO.15.5

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Test Methods for Firewood Stoves - A Technical Review

Short introductive summary:

Third party testing of direct heating appliances fuelled with firewood has been established in many countries worldwide. The main goals are ensuring operation safety and a minimum level of performance of the products prior to market implementation. This kind of approval procedure for new products requires testing standards, certified testing bodies and a legal framework defining minimum requirements for specified performance parameters which are assessed in the respective standards.

While the overall targets are quite similar for all countries having set-up such procedures, the practical implementation of these targets in the testing standards is remarkably different. This applies to both, the way of operating the appliance during the testing and the measurements performed during the testing.

Several industries were requested recently to modify their product standards towards more realistic operating conditions. The most famous example is car industry, but this request may also apply to biomass heating systems. This study sheds some light on existing standards, advanced methods and real life performance and draws conclusions for future development.

Presenter: **Christoph SCHMIDL, Bioenergy 2020+, Biomass Combustion Dpt., Wieselburg-Land, AUSTRIA**

Presenter's biography:

PhD in Technical Chemistry at Vienna University of Technology on Gaseous and Particulate Emissions from Biomass Combustion. Since 2009 Senior Researcher at the research centre Bioenergy2020+. Since 2013 head of master program "renewable energy" at University of applied sciences Wr. Neustadt.

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Session reference: IBO.16.1

Subtopic: 6.3 Power & Heat processes and systems

Topic: 6. INDUSTRY SESSIONS



## Experimental Study of PM Emissions from Wood Pellet Stoves with Innovative Burning Pots

Short introductive summary:

This work regards the analysis of factors that influence PM emissions in a commercial stove model. In particular results of an extensive set of experiments on wood pellet stoves equipped with an innovative burning pot are presented.

Tests have been performed to investigate the relations between design data and operation parameters of the stove and its emissions. In particular, carbon monoxide (CO) and particulate matter (PM) emissions are correlated to the burning-pot depth and to inlet air flow rate and its distribution among primary, secondary, and tertiary combustion air. The burning pot, recently patented by AICO SpA, allows to obtain near-to-zero CO emissions and low PM emissions: however, PM emission reduction with respect to standard burning pots is not as enhanced as CO emission reduction. Aiming to understand and improve performance of the burning pot, it is shown as increasing the burning pot depth, PM emissions can be decreased down from 12~15 mg/Nm<sup>3</sup> to 7~10 mg/Nm<sup>3</sup>.

Presenter: **Luigi POLONINI, University of Brescia, Mechanical engineering Dpt., Ospitaletto, ITALY**

Presenter's biography:

I am Luigi Polonini, a PhD student of the University in Brescia (Italy) and I'm 29 years old.

I've studied mechanical engineering at the University of Brescia and, after two years of work in companies I started my PhD program in collaboration with a manufacturer pellet company Ravelli Spa.

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Session reference: IBO.16.2

Subtopic: 6.3 Power & Heat processes and systems

Topic: 6. INDUSTRY SESSIONS

## **Experimental Investigation on How NO<sub>x</sub> Formation Depends on Boiler Load in a Large Utility Bubbling Fluidized-Bed Boiler**

Short introductive summary:

For boiler suppliers, the predictive capability of nitrogen oxides (NO<sub>x</sub>) formation is an important competitive factor. Several factors have been investigated in the literature and have proven to be more or less important in the prediction of NO<sub>x</sub> formation. One factor that has not been well documented is the NO<sub>x</sub> formation at different boiler loads. Using the existing knowledge in literature on the different operational parameter effects on NO<sub>x</sub> formation, lower loads would result in a higher conversion level of fuel nitrogen into NO<sub>x</sub>. A one-week test campaign was conducted by Babcock & Wilcox (B&W) on a 50 MW thermal input bubbling fluidized-bed (BFB) boiler to obtain real data on NO<sub>x</sub> emissions and its dependence on boiler load and O<sub>2</sub> levels. Four load ranges were tested from 100% down to 30% load. The test revealed that within each load range a lowered O<sub>2</sub> level does result in lower NO<sub>x</sub> formation, all according to the literature. Looking instead at all load ranges, the NO<sub>x</sub> formation shows a slight decrease as load decreases. The work presented here provides additional material for effective predictive methods of NO<sub>x</sub> formation at different loads which can help in selecting the most suitable NO<sub>x</sub> reduction method for each application.

Presenter: **Henrik HOFGREN, Babcock & Wilcon Vølund A/S, Glostrup, DENMARK**

Presenter's biography:

Dr. Hofgren is currently working as a technology specialist within combustion at the R&D department of Babcock & Wilcox Vølund A/S. His Ph.D. from 2015 focused on both modeling and experimental work of thermal radiation in combustion environments.

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Session reference: IBO.16.3

Subtopic: 6.3 Power & Heat processes and systems

Topic: 6. INDUSTRY SESSIONS

## The Effects of Operational Conditions on Agglomeration in a Fluidized Bed Combustor Using Biomass

Short introductive summary:

Fluidized bed combustion (FBC) technology is commonly used at the industrial scale for the combustion of biomass fuels, due to its ability to handle fuels of varying qualities. However, there are still several challenges associated with biomass use in FBC units such as agglomeration, whereby bed material sticks together due to the formation of alkali-silicate melts. This study looks at agglomeration from the perspective of how operational variables and conditions affect the speed and severity of agglomeration, with a particular focus on emissions behaviour. Three biomass fuels have been used with a pilot scale 50-75kWth FBC unit. Bed height, gas velocity, bed material (quartz sand or olivine), and particle size of olivine have been varied, with temperatures, pressures and emissions monitored. SEM/EDX analysis of the agglomerate samples has also been performed to determine structural and compositional variances.

Presenter: **Jonathan MORRIS, University of Sheffield, Energy 2050, Sheffield, UNITED KINGDOM**

Presenter's biography:

Jonathan is an Engineering Doctorate (EngD) student with the Carbon Capture, Storage and Cleaner Fossil Energy (CCSCFE) CDT. He is investigating agglomeration during fluidized bed combustion of biomass, and collaborates with Sembcorp Utilities UK who operate "Wilton 10": a biomass CHP station.

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Session reference: IBO.16.4

Subtopic: 6.3 Power & Heat processes and systems

Topic: 6. INDUSTRY SESSIONS

## **Numerical Parametric Investigation of a Flexible Lignite-Fired Boiler Operating with Pre-Dried Lignite or Biomass as Supporting Fuel**

Short introductive summary:

This work presents a comparative investigation of the operation of Megalopolis IV pulverized lignite-fired boiler, located in Megalopolis, Greece, at very low thermal load, i.e. 35% of the nominal one, far below its current technical minimum (~55%). In order to achieve stable operation at this low thermal load, the boiler takes advantage of a co-firing scheme using as supporting fuel either pre-dried lignite (PDL) or biomass (olive pomace). The numerical investigation of the boiler has been conducted using the commercial software ANSYS Fluent v15.0, supported by in-house built functions for the combustion rate of the fuels and the drag force exerted on biomass particles.

Presenter: **Panagiotis DROSATOS, Institute for Solid Fuels Technology & Applications, Melissia, GREECE**

Presenter's biography:

I am a mechanical engineer and i graduated from NTUA in 2013. Since then, I have been working as research associate in CERTH. i am currently conducting my PhD research examined the numerical simulation of several co-firing strategies for enhancement of lignite-fired boilers flexibility.

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Session reference: IBO.16.5

Subtopic: 6.3 Power & Heat processes and systems

Topic: 6. INDUSTRY SESSIONS

## Syngas Biomethanation by Enriched Anaerobic Sludge in a Trickle Bed Reactor

Short introductive summary:

Gasification of biomass results to the production of syngas (mainly of H<sub>2</sub>, CO and CO<sub>2</sub>) with a very high (more than 90%) conversion efficiency. Syngas can be biologically converted to biofuels such as methane and alcohols. CH<sub>4</sub> is an important energy carrier and has the advantage to be easily introduced in the natural gas grid; therefore syngas biomethanation has the potential to contribute substantially to the storage of biomass-derived energy. Our study focuses on the development of a bioprocess that will overcome the current bottlenecks of syngas bioconversion which are the need to maintain sterile conditions and the mass transfer of sparingly soluble syngas compounds to the water-based media.

Presenter: **Konstantinos ASIMAKOPOULOS, Technical University of Denmark, Chemical and Biochemical Engineering, Valby, DENMARK**

Presenter's biography:

2016-2019: Ph.D. student at Technical University of Denmark

2010-2015: Chemical Engineering (5 years program – BSC and MSC), National Technical University of Athens, Diploma Grade: 9.24/10 (Excellent)

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Session reference: 3BV.7.6

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Biorefining of Eucalyptus Biomass Using Organic Solvent Gamma-Valerolacetone

Short introductive summary:

This project was aimed at investigating the potential use of Gamma-Valerolacetone (GVL) as an organic solvent for the fractionation of eucalyptus biomass. Temperature, solvent concentration and duration were investigated over the range of 120-180°C 35-60% w/w and for durations of 5 minutes to 2 hours. The optimisation was undertaken to reach elevated levels of lignin and hemicellulose solubilisation 94 and 99% respectively, whilst minimising cellulose hydrolysis to produce a residual biomass with a cellulose content of 89.3%. Subsequent tests into recovery of the solvent produced promising results greatly improving the financial feasibility the project. It was also determined that shorter operational durations can be used at lower than previously reported temperatures indicating significant reductions in the operational energy. Analysis of the cellulose fibres following this treatment determined that highly crystalline fibril aggregates were generated that have high potential for use in Nano-polymer industry. The work found that with continued investigation into solvent recovery and upscaling a this may be providing a great platform for biorefinery for forestry industry

Presenter: **Raymond TREVORAH, RMIT, School of Engineering, Melbourne, AUSTRALIA**

Presenter's biography:

I am a PhD candidate researching Biorefining of forestry waste using organic solvents. I have previously worked on Bioethanol and Biogas projects, with both government and industry collaboration.

I am highly interested by internal lignocellulose structure and its impacts on the use of the fraction

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Session reference: 3BV.7.9

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Syngas Fermentation by Mixed Microbial Consortia: Enrichment and Continuous Fermentation

Short introductive summary:

Syngas fermentation is one of the most promising approaches within second generation biofuel production technologies. The potential of syngas fermentation carried out by mixed microbial consortia has been demonstrated for a number of products such as H<sub>2</sub>, CH<sub>4</sub>, carboxylic acids and higher alcohols. However, studies reporting the successful production of ethanol as a major product of the fermentation are still very limited.

In this study, pH-based enrichment strategies were designed in order to develop an enriched microbial consortium with high selectivity towards ethanol. Subsequently, the effects of key operational parameters for the production of ethanol were evaluated in a continuous syngas fermentation process.

**Presenter:** **Antonio GRIMALT ALEMANY, Technical University of Denmark, Department of Chemical and Biochemical Engineering, Lyngby, DENMARK**

Presenter's biography:

Antonio Grimalt-Alemany is a PhD candidate at the Technical University of Denmark currently working on biofuels production through synthesis gas fermentation using open mixed microbial consortia. His research interests focus on fermentation-based processes for biomass and waste valorization.

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Session reference: 3BV.7.10

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Integrated Biorefinery Concept for the Full Valorization of Sustainably Grown Lignocellulosic Biomass**

Short introductive summary:

To foster a future bio-economy the conversion and full valorization of sustainably grown lignocellulose in holistic bio-refineries is a promising option that still needs further development. Important steps for such biorefinery processes are i) to reduce the ecological footprint by using biogenic materials – including catalysts and solvents – ii) to enable efficient (waste)water, solvent and catalyst recycling and iii) to reach economic targets by reducing fertilizer costs and/or utilizing plants from marginal soils that avoid competition with food production.

Presenter: **Philipp GRANDE, Forschungszentrum Jülich, Aachen, GERMANY**

Presenter's biography:

Chemist

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Session reference: 3BV.7.11

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Hydroprocessing Modeling Toolkit for Process Design

Short introductive summary:

Bio-oil is a mixture of over 300 complex oxygenated hydrocarbons, whereas 40-50% of its composition is detectable and only ultimate analysis is 100% known. It has high water content (15-30 wt.%), high corrosiveness and viscosity. In addition, due its high oxygen content, it has low energy density, is thermally unstable and therefore, cannot be used directly as a fuel.

Hydroprocessing is an upgrading method which is conducted at T=300-400 oC, high pressure (100 bar) and excess of hydrogen (200 L/L H<sub>2</sub>/oil). It aims at bio-oil's oxygen reduction and thermal stabilization. Common hydrotreating catalysts are based on Co and Ni, as well as on noble metals, such as Pt, Pd and Ru.

Our work focuses on developing three different AspenPlus<sup>TM</sup> modeling approaches, based on the available experimental data.

Presenter: **Kyriakos PANOPOULOS, Centre for Research & Technology Hellas, Chemical Process & Energy Resources Institute, Thessaloniki, GREECE**

Presenter's biography:

Dr. Kyriakos D. Panopoulos is currently a researcher Centre for Research and Technology Hellas/ Chemical Process and Energy Resources Institut. He currently leads a research group on the fields of gasification and biofuel production.

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Session reference: 3BV.7.12

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Construction of Thermostable Cellulases

Short introductive summary:

We have isolated hyperthermophilic cellulases from hyperthermophilic archaea collected from deep-sea in extreme environment and characterized them. The functional and structural analyses for these enzymes were carried out. These enzymes have the potential for the biomass degradation at high temperature (over 100°C). Using the rule of protein stability, we have constructed the additional thermostable cellulase from fungi with protein engineering method.

Presenter: **Kazuhiko ISHIKAWA, National Institute of Advanced Industrial Science & Technology, Biomedical Research Institute, Ibaraki, JAPAN**

Presenter's biography:

Kazuhiko Ishikawa holds a PhD in enzyme chemistry at Kyoto University. His current research addresses thermophilic enzymes for biomass conversion

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Session reference: 3BV.7.15

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Fractionation of Olive Woody Waste (Oww) Obtained after Milling by Hydrothermal Pretreatments - Steam Explosion and Hot Water**

Short introductive summary:

The olive woody waste constitutes a promising feedstock for biorefineries in the Mediterranean region. In order to valorise this lignocellulosic residue, a pretreatment is necessary to fractionate its components and to improve the cellulose enzymatic hydrolyzability. The work target was to compare the efficiency of two physico-chemical pretreatments, viz.: Steam Explosion and Liquid Hot Water towards aqueous fractionation of OWW and enzymatic digestibility of the cellulosic residue.

Presenter: **Francesco ZIMBARDI, ENEA Research Centre, Energy Technologies Dpt., Rotondella, ITALY**

Presenter's biography:

Graduated in industrial chemistry, fellow at the combustion institute of Naples 4y before joining ENEA a public body depending from the ministry of economy. His current interests are biomass pretreatment for sugar/biofuel production and thermal conversion of biomass by gasification and pyrolysis.

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Session reference: 3BV.7.17

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

**Valorization of a Side-Stream from the Organosolv Process for Sustainable Production of Added-Value Compounds**

Short introductive summary:

Fractionation of lignocellulosic biomass with solvents (organosolv process) generates a hemicellulose-rich liquor with a high content of phenolics which is particularly toxic. This work addresses the utilization of this stream for the production of ligninolytic enzymes (LE) by white rot fungi. Fungal treatment allowed the reduction of the acute toxicity of the stream. Furthermore, ganoderic acid, which is an important bioactive substance was obtained from the mycelium and spores of *Ganoderma lucidum* after the LE recovery process. These results and a preliminary economic analysis suggest that further development and optimization of this approach could eventually enable the scalable production of added-value compounds using the hemicellulose-rich liquor from the organosolv process.

Presenter: **Gemma EIBES, University of Santiago de Compostela, Department of Chemical Engineering, SANTIAGO DE COMPOSTELA, SPAIN**

Presenter's biography:

Chemical Engineering Degree, 2001

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Currently, postdoc researcher.

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Session reference: 3BV.7.19

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Concentrated Glucose as an Industrial Fermentable Sugar Produced from Miscanthus with KRICTBiosugar® Process**

Short introductive summary:

Production of the concentrated glucose with miscanthus by hydrothermal treatment, enzymatic hydrolysis, and membrane concentration, and, the assessment of biological availability of the sugar by production test of L-lysine with *Corynebacterium glutamicum*

Presenter: **Ju-Hyun YU, Korea Research Institute of Chemical Technology, Center for bio-based chemistry, Daejeon, REPUBLIC OF KOREA**

Presenter's biography:

I am a 57 year old man, working for a public research institute studying on chemical technology in South Korea. My research goal is the commercialization of lignocellulosic fermentable sugar, which is named as KRICTBiosugar Process.

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Session reference: 3BV.7.20

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Syngas Transformation Technologies to Produce Biofuels and Biochemicals - A Techno-Economical Review**

Short introductive summary:

The research is focused on gaseous products of pyrolysis and gasification (syngas) treatment and utilisation for biochemicals and biofuels production.

Presenter: **Petr SEGHRMAN, Czech Technical University in Prague, Department of Process Engineering, Prague, CZECH REPUBLIC**

Presenter's biography:

- born 9th July 1993 in Slaný
- in september 2017 finished Ing. studies in Proces Engineering
- since then studying PhD in Process Engineering

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Session reference: 3BV.7.23

Subtopic: 3.6 Biorefineries

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Production of High Value Algal Biomass in Effluent Streams

Short introductive summary:

In this study *Chlorella sorokiniana* and *Arthrospira platensis* are cultivated in municipal wastewater and digestate to compare the quantity of valuable compounds (proteins, lipids [incl. PUFAs], pigments) in biomass produced in these effluents and in mineral media. Additionally, factors to enhance the biomass production are considered in wastewater and digestate. Finally, the potential of nutrient removal by microalgae is evaluated.

Presenter: **Bernhard DROSG, Bioenergy 2020+, Tulln, AUSTRIA**

Presenter's biography:

Dr Bernhard Drosch is Senior Researcher at BOKU University and Area Manager for "bioconversion and biogas systems" in the Austrian Competence Centre bioenergy2020+. In addition, he represents Austria in the IEA Bioenergy Task 37 on Biogas.

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Session reference: 1BV.8.2

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## **Effect of Phosphorus Limitation on the Fatty Acid and Phospholipid Synthesis in Chlymydomonas SP Under Long Term Cultures**

Short introductive summary:

Studies on cultured algae have been carried out to determine taxonomic differences in the lipid composition of major groups and to determine the effect of physiological and environmental changes on algal biomes and lipid production

Presenter: **Huda QARI, Kau University, Cheshire, UNITED KINGDOM**

Presenter's biography:

I am associate Professor in Freshwater and plankton ecology, King Abdulaziz University,.More than 38 research paper are published .My research skills in aquatic research, algal biofuel, wastewater treatment & biodegradation, lipid extraction, & Chromatography analysis.

for more information click on

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Session reference: 1BV.8.5

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES



## Phytosterols and Other High Valuable Products Investigation from Tetraselmis Suecica Growth Tests

Short introductive summary:

Microalgae as source of bioactive molecules, such as pigments and lipids, are receiving increasing interest in many fields with a special focus in healthy and nutritional implications.

This study evaluates the potential of the microalgal strain *Tetraselmis suecica*, well-known in literature for biomass and oil production, as source of phytosterols and other high valuable products for the nutraceutical sector. Different growth tests were performed changing light intensity using a photobioreactor equipped with adjustable intensity LED lamps, which allowed to stress the microalgae cultures in order to produce phytosterols as self-light-defense. Three tests at increasing intensity were performed. The sterol fraction was extracted at the end of every test by a specific kit and then analyzed and quantified by a GC-MS apparatus. During the tests an interesting color modification occurred, attributable to a response to irradiation increases, addressing the study to the analysis and quantification of the possible pigments implicated, with a particular focus on the total carotenoids content.

Presenter: **Giulia LOTTI, RE-CORD, UNIFI, Firenze, ITALY**

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Session reference: 1BV.8.6

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

**The Effects of Algal Extracellular Secretion (Aes) on the Growth, Metabolism and Medium Recycle of Two Screened Microalgae Scenedesmus Sdec-8 and Chlorella Sdec-18**

Short introductive summary:

One of the bottlenecks in large-scale production of microalgae is the huge consumption of water. Therefore, recycling the medium is indispensable. However, algal extracellular secretion (AES) will accumulate in the medium. These secretions will exert adverse effects on algal growth and lipid accumulation, and could not be removed during conventional harvest.

This study revealed that the AESs were continuously released into the medium by microalgae, especially during the lag and stable phases. Based on the calculated relationship between the biomass and AESs, we found that the release rate of AES in the lag and stable phases were significantly higher than that in exponential phase. In addition, the AES release rates during lag and stable phases increased with the recycle times of medium, but that of exponential phase had little changes. Both the maximum biomass concentration and lipid content appeared in the primary cultivation. After the 4th time, the growth and lipid accumulation were obviously limited by the AES. But accumulating AES stimulated the carbohydrate biosynthesis in both two algae. Strategy should be exploited to remove AES for long-term recycle of algal medium.

Presenter: **Ze YU, Jinan, P.R. CHINA**

Presenter's biography:

A PhD student in Shandong University and interested in microalgae-energy production.

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Session reference: 1BV.8.7

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## **Scale-Up Culture of Spirulina Subsalsa Biomass from Seawater Combined with Monosodium Glutamate Residue**

Short introductive summary:

Microalgae are becoming important feedstock for biofuels and other high-value products, but are currently difficult to produce economically at a large scale, in part due to freshwater and nutrient costs.

In the study, we used seawater and residue (MSGR) from a monosodium glutamate production process, to culture *Spirulina subsalsa* biomass without any freshwater and chemicals cost. The algae grew successfully in the media in a baggy reactor and produced lipid, protein, minerals and polyunsaturated fatty acids efficiently. Moreover, the media could be used twice for algal cultivation to minimize material waste.

Seawater with MSGR can potentially be used to culture *S. subsalsa* and get algal biomass economically at a large scale. Moreover, the cultivation with a bag is easy to implement from getting reactor and medium to silk-filtration harvest for food, feed and fertilizer.

Presenter: **Liqun JIANG, Shandong University, Environmental Science and Engineering, Jinan, P.R. CHINA**

Presenter's biography:

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Session reference: 1BV.8.8

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## Opportunities and Challenges in Application of Co-Cultivation System with Seawater and Wastewater for Microalgae Cultivation: a Review

Short introductive summary:

Algae-biofuel commercialization due to present high-cost investment still represents a long and demanding journey. Bioprospecting of microalgae capable of growing and hyperaccumulating lipid in waste/seawater, can pave a path for commercialization of microalgae-based biodiesel. Till date, seawater cultivation mainly concentrated on the target of marine algae or seawater just as a low-proportion supplement to freshwater algae culture medium. For wastewater cultivation, huge freshwater was usually consumed primarily for the dilution effect in wastewater. This review proposed a co-cultivation system: salinity in seawater combined with a dash of nutrients from wastewater can accelerate the application of algal biofuels, which could prompt downsizing of natural resources like freshwater and nutrients.

We provide a critical analysis on the co-cultivation system including what species are suitable and what benefits and the challenges of the system, as well as the promising outlook of the co-cultivation system works together with kitchen waste anaerobic digestion process.

Presenter: **Zhigang YANG, Beijing Elion Smart Energy Technology Co.Ltd., P.R. CHINA**

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Session reference: 1BV.8.9

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## Can Mariculture Wastewater Become Feed for Microalgae Cultivation?

Short introductive summary:

Microalgae are one of the most diverse group of species that have gained immense interest due to their potential use in biofuel industry. Nevertheless, the high cost of freshwater and nutrients associated with large scale production infers a long road ahead for their commercialization as sustainable biodiesel.

In this study, we choose mariculture wastewater after fish and holothurian cultivation (MWF and MWH), respectively, as nutrient substrates for cultivation of *Chlorella sorokiniana* SDEC-18. The algal growth in mariculture wastewater had obvious gap with that in BG11 medium. Fortunately, due to salinity stress and nutrient deficiency in mariculture wastewater, algae hyperaccumulated lipids, about twice as high as that in BG11 medium. And the factors that retarded the algae growth were also been revealed, such as extracellular secretion from fish and holothurians, and low nutrients, especially phosphorus, which would help us to increase the algae growth rate.

Presenter: **Lijie ZHANG, Shandong University, School of Environmental Science and Engineering, Jinan, P.R. CHINA**

Presenter's biography:

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Session reference: 1BV.8.10

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## Determining the Co-Product Potential of Microalgae Cake

Short introductive summary:

Algal biomass by-product, produced by industries that extract and use the oil from microalgae, is often considered a waste product. Partnering with an industrial consumer food and cosmetic company we have explored the potential of the pressed cake algal biomass, which results from the company's extraction process, as a co-product rather than waste. The pressed cake is expected to contain valuable carbohydrates and other organic polymers, which could be used as a substrate for bioenergy processes or as a feedstock for various bioproducts. We have explored this potential by implementing a FAME-based lipid analysis using GC-FID to determine the lipid profile of residual oil. We have also used acid hydrolysis to identify and quantify the sugars present, and have identified the structure and chemical properties of the residual lignin using thioacidolysis. The physicochemical and physicomachanical properties of the material have also been explored, such as the energy density (HHV) as well as pellet strength and durability. The data have revealed characteristics of the pressed cake that may allow it to become a high-value co-product to the bioenergy, pharmaceutical, consumer fo

Presenter: **Elizabeth NIXON, Eastern Illinois University, Biological Sciences, Charleston, USA**

Presenter's biography:

Elizabeth Nixon is a Masters Candidate in Biological Sciences and Sustainable Energy at Eastern Illinois University. She completed her Bachelors of Science in Environmental Science at the University of North Carolina Wilmington. After graduating, she hopes to research biofuels.

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Session reference: 1BV.8.15

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## **Numerical Investigation of Hydrodynamic Conditions in a Pilot Tubular Photobioreactor**

Short introductive summary:

I am a student of doctoral program under co-tutoring agreement between Czech Technical University in Prague and Universitat Politècnica de Catalunya. The aim of my research plan is a scale-up of microalgae cultivation system and its application at industrial scale.

Presenter: **Vojtech BELOHLAV, Czech Technical University in Prague, Process Engineering Dpt., Prague, CZECH REPUBLIC**

Presenter's biography:

I am a student of Czech Technical University in Prague, Process Engineering and Universitat Politècnica de Catalunya, Environmental Engineering and Microbiology Group. I am interested in algae production, design of algae cultivation system in industrial scale and biomass pretreatment processes.

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Session reference: 1BV.8.17

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## **Lignocellulosic Materials as Carriers for Algal Biofilm Cultivation: Effects of Material Surface Roughness and Particle Size**

Short introductive summary:

this study is about using lignocellulosic materials as algal biofilm carriers for algal biofilm cultivation in a self-design thirty-channel algal biofilm reactor to lower the biomass production cost relating to carriers. meanwhile, the effects of material surface roughness and particle size on the performance of the carriers were also addressed via CFD and confocal laser-scanning technology

Presenter: **Qi ZHANG, Huazhong University of Science and Technology, School of Energy and Power Engineering, P.R. CHINA**

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Session reference: 1BV.8.18

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES



## **Biofuel from Marine Micro Algae (Indian Species): Marine Environment to Lab And Lab to Land Technology**

Short introductive summary:

Isolation of local species and identification of biofuel potential (Large scale open air pond cultivation)

Presenter: **Selvakumar PALANISAMY, CSIR-National Institute for Interdisciplinary Science and Technology (NIIST), Environment Technology Division, Trivandrum, INDIA**

Presenter's biography:

I am Dr.P.Selvakumar,  
M.Phil and PhD in Algal biotechnology  
CSIR-Nehru Science Post doctoral Fellow @ CSIR-NIIST Trivandrum  
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Session reference: 1BV.8.20

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## Energy Storage and Balancing Power for 100% Renewable Energy Hybrid Systems: the Potential of Jatropha for Rural Electrification in Hot Semi-Arid Areas

Short introductive summary:

Almost all Jatropha projects from the Jatropha hype around 2008 failed, due to misled expectations about yield, oil prices and international export markets. In contrast, advanced Jatropha projects nowadays focus on agricultural unused land in hot semi-arid areas and decentralized production and consumption strategies within closed CO<sub>2</sub> and energy cycles based on regional home markets. Jatropha oil as engine fuel is solar stored liquid energy, used as balancing power within 100 renewable energy hybrid systems for electricity production next to photovoltaic and/or wind power. In a global approach and up to 2050, the research paper analyses the technical functionality, the economics and the global potential production area and yield of Jatropha in hot semi-arid drylands in Africa, Asia and Latin America. The VWP "CO<sub>2</sub> Recycling Concept for Fuel, Food, Feed and Fertilizer" from "Decentralized Social Business Jatropha Biorefineries" are a powerful tool against poverty, climate change, desertification and migration. A pilot project on the Galapagos Islands was awarded as Best International Off Grid Project 2017 from the Alliance for Rural Electrification.

Presenter: **Georg GRUBER, Vereinigte Werkstätten für Pflanzenöltechnologie, R&D, Allersberg\_Göggelsbuch, GERMANY**

Presenter's biography:

Dr.phil. Georg Gruber studied Economics and Natural Resource Management in Erlangen/Nürnberg, Germany, and Santa Barbara, California, U.S.A. Mr. Gruber is working for 30 years on pure plant oil as fuel, is co-owner of VWP and keeps 15 patents on engine technology, fuel production and fuel quality.

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Session reference: 1BV.8.22

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES

**Modeling and Optimization of Integrated Biomass Logistics Networks for Biofuel Production**

Short introductive summary:

The implementation of efficient logistics networks are required to reduce the biomass delivery cost and enable biofuels as a competitive transportation fuel. The majority of the biomass-to-biorefinery supply chain network design models included the single objective of reducing operational and transportation costs without considering the biomass supply and quality uncertainty. The proposed model integrates physical and chemical biomass properties since they exhibit a significant variability in their composition. Moreover, the variation in the biomass properties affect the cost of the final biofuel. An stochastic hub-and-spoke model is proposed in this paper to design a supply chain in order to take advantage of economies of scale and reduce the total cost of transportation. Noteworthy, moisture and ash content are introduced in the model since they affect operations such as transportation, storage and conversion, among others. A case study in the South Central Region of the U.S. is presented and numerical experiments are run and analyzed to draw the conclusions. Corresponding results are discussed.

Presenter: **Krystel CASTILLO, The University of Texas at San Antonio, San Antonio, USA**

Presenter's biography:

Dr. Krystel Castillo is currently the GreenStar Endowed Associate Professor in Energy in the Department of Mechanical Engineering and Director of the Texas Sustainable Energy Research Institute (TSERI-texasenergy.utsa.edu) at The University of Texas at San Antonio.

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Session reference: 1BV.8.23

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES

**Biomass Production and Feedstock Diversification for Advanced Biofuels: the Becool Project**

Short introductive summary:

The main objective of the BECOOL project "Brazil-EU Cooperation for Development of Advanced Lignocellulosic Biofuels" is to strengthen EU-Brazil cooperation on advanced lignocellulosic biofuels. The project covers the whole value chain, from biomass production, to logistics and conversion. This paper will be focused on the implemented biomass production and diversification strategies. In the BECOOL project, integrated biomass supply systems will be implemented encompassing abundant crop/process residues such as cereal straw, sugar cane straw and bagasse (about 330 million metrics tons generated annually in Brazil) as well as lignin-rich residues derived from the biochemical conversion of lignocellulosic feedstock to advanced ethanol. In addition dedicated annual lignocellulosic crops will be grown with conventional crops in innovative cropping rotation systems, as well as perennial grasses. Harvesting and handling of all feedstocks will be sufficiently investigated, along with field drying, baling or comminution, densifying, to enhance the quality and quantity of harvested feedstocks, while reducing transport, handling and storage.

Presenter: **Myrsini CHRISTOU, Center for Renewable Energy Sources and Saving, Biomass Dpt., Pikermi, GREECE**

Presenter's biography:

Agriculture engineer, MSc, leader of CRES Biomass department. Over 25 years of experience as coordinator and scientific responsible in a range of European and national RTD projects on technical evaluation of several biomass feedstocks in integrated biomass value chains for energy and biorefinery concepts.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 1BV.8.26

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES

## **Future Potential Of Biogas as a Part of Sustainable Agriculture - Case Study of North Savo, Finland**

Short introductive summary:

The research is part of the SUSTAg-project funded from Facce Surplus programme. We have three case study regions, from which one is North Savo in Finland. The project aims for sustainable intensification of agriculture and in the case of North Savo region, this means combining food, feed and energy production.

Presenter: **Erika WINQUIST, Natural Resources Institute Finland, Espoo, FINLAND**

Presenter's biography:

Projects/Duties: Utilization of biomass in production of feed, chemicals and energy, biorefinery projects. Special competence: biotechnology, chemical technology, environmental technology, soil chemistry

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Session reference: 1BV.8.27

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES

## Assessing Options for the Sustainable Intensification of Agriculture for Integrated Production of Food and Non-Food Products at Different Scales (SUSTAg)

Short introductive summary:

Sustainable agricultural intensification offers the opportunity to simultaneously address food security and non-food crop demand for the bioeconomy, while reducing negative impacts of agriculture on the environment. The overarching aim of the SUSTAg project is to identify sustainable intensification (SI) measures and integrated production systems of dual food and non-food production at the global, European and regional levels, towards a competitive and sustainable European bioeconomy. For the evaluation of SI options and dual production systems, we employ scenario assessment via integrated modelling at different scales (global, EU, regional), stakeholder engagement in three regional case studies (Finland, Germany, Spain), and flexible SI metrics considering production conditions, dynamics in demand for food and non-food products, resource use and availability, environmental impacts, socio-economic and policy environments, and climate change. The outcome of SUSTAg is the evaluation of stakeholder relevant SI options, dual production systems, and bioeconomy supply chains for sustainably increasing value creation within an emerging European bioeconomy.

Presenter: **Christoph MÜLLER, Potsdam Institute for Climate Impact Research, Potsdam, GERMANY**

Presenter's biography:

Christoph Müller works at PIK, Germany, and holds a PhD in geo-ecology. Christoph leads the PIK research group on multi-sector impacts and climate extremes and co-leads the global land-use team. He is the co-principle investigator of GGCM within AgMIP.

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Session reference: 1BV.8.28

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES

## Agroforestry Systems in Europe - Roles and Functions in Diverse Socio-Economic Contexts

Short introductory summary:

### Project funding

SustainFARM was selected for funding in a competitive process among 67 proposals, following an evaluation by an international panel of reviewers: <http://facceturplus.org/joint-calls/first-call/>. SustainFARM is a transnational research project funded by ERA-NET Cofund FACCE SURPLUS (Sustainable and Resilient agriculture for food and non-food systems), in collaboration between the European Commission and a partnership of 15 countries in the frame of the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI). FACCE SURPLUS is committed to improve collaboration across the European research landscape in diverse, integrated food and non-food biomass production and transformation systems, including bio refining.

Presenter: **BB GHALEY, University of Copenhagen, Department of Plant and Environmental Sciences, Taastrup, DENMARK**

Presenter's biography:

Bhim Bahadur Ghaley has a background in molecular plant breeding and agronomy and has extensive experience in field trial planning and execution, agronomy/field crop production, nutrient uptake and utilization, <sup>15</sup>N stable isotope use, cultivar screening for pest and disease and crop modelling.

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Session reference: 1BV.8.30

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES

## Assessment of the Potential of Green Floating Filters for Bioenergy Production

Short introductive summary:

The proof of concept is being undertaken under the EU Life+ Programme, in the framework of the just-started project 'Life Biomass C+', Project coordinated by the Centre for Research and Technology Hellas (CERTH, Greece) and participated by the Technical University of Madrid (UPM, Spain), the Irrigation Community of El Arenal (COMRA, Spain), Hellenic Petroleum S.A. (HELPE, Greece), BIOSTREAM (Netherlands) and Volterra Ecosystems SL (VOLTERRA, Spain).

**Presenter:** **Dimitrios-Sotirios KOURKOUMPAS, CENTRE FOR RESEARCH & TECHNOLOGY HELLAS, Chemical Process & Energy Resources Institute, Maroussi, Athens, GREECE**

Presenter's biography:

Mr. Dimitrios-Sotirios Kourkoumpas is a research engineer at CERTH. He is a MSc Mech. Engineer with MSc diploma in Energy and Environmental Management. He is specialized in biomass and waste to energy processes, as well as in the simulation of integrated energy projects, esp. through LCA modelling.

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Session reference: 1BV.8.31

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES



## Design of Pilot Plant and Industrial Photobioreactors: A Critical Technical Study

Short introductive summary:

Petrochemical, food and processing technologies produce a large number of emissions and waste heat. There is, therefore, a potential to use emission gases, rich for CO<sub>2</sub> especially, together with waste heat to produce algae-based biofuels and to reach a concept of emission-free technology – these are third generation biofuels.

CO<sub>2</sub> is the most important nutrient component for algae. Generally known, the transformation of both CO<sub>2</sub> and waste to algae occurs in photobioreactors of various technical configurations, nowadays primarily in lab scale. Today are known five main types of photobioreactor - open pond, tubular, plastic bag, column airlift, and flat-panel airlift reactors, that have potential for scale-up to industrial scale.

The purpose of this study is critically overview design and process configurations of photobioreactor designs in the pilot and full scale.

**Presenter:** **Terézia ŽÁKOVÁ, Czech Technical University in Prague, Faculty of Mechanical Engineering, Department of Process Engineering, Prague, CZECH REPUBLIC**

Presenter's biography:

I am phd student at the Czech Technical University and I study process engineering on Department of Process Engineering. Field of my inters is mainly photobioreactors, algae and biofuels. I started with this topic within my diploma thesis, so I decided continues with this.

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Session reference: 1BV.8.33

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

### **Lab scale cultivation of Baltic *Ulva intestinalis* in different light and nutrient conditions: Effects on growth and morphology**

Short introductive summary:

Seaweed cultivation laboratory has been developed, but some seaweed cultivation aspects are still unclear. Nutrients and different lighting systems were first parameters to be tested to improve seaweed maintenance and providing best growth conditions for Baltic seaweed species, which are adapted for low salinity in this region.

Presenter: **Karina BALINA, Riga Technical University, Institute of Energy Systems and Environment, Riga, LATVIA**

Presenter's biography:

Karina Balina gained her Bachelor and Master degrees in University of Latvia Faculty of Biology. She studied aquatic toxicology and hydrobiology. Now she is doing her PhD on seaweeds in Riga Technical university and working as a doctoral researcher in Institute of Energy Systems and Environment.

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Session reference: 1BV.8.34

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## **Selection and Establishment of Crops In Abandoned and Unused Land for Energy Purposes at Cambrils Agricultural Cooperation in Spain**

Short introductive summary:

The paper was carried out into the framework of the Life "Coop 2020 Project "Pilot for rural smart grids through optimisation of energy use and innovative renewable biomass sources".

The main objective of this study was to demonstrate the economic and environmental viability of a new business model for agricultural cooperatives, integrating energy savings and the generation of renewable energies and biomass production. Over the last decade European agricultural cooperatives had to cope with increasing financial pressure due to stagnating prices of their products combined with an augmentation of expenses, especially of electricity and fuel.

Presenter: **Dimitrios-Sotirios KOURKOUMPAS, CENTRE FOR RESEARCH & TECHNOLOGY HELLAS, Chemical Process & Energy Resources Institute, Maroussi, Athens, GREECE**

Presenter's biography:

Mr. Dimitrios-Sotirios Kourkoumpas is a research engineer at CERTH. He is a MSc Mech. Engineer with MSc diploma in Energy and Environmental Management. He is specialized in biomass and waste to energy processes, as well as in the simulation of integrated energy projects, esp. through LCA modelling.

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Session reference: 1BV.8.36

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES

## Mass Culture of Chlorella Pyrenoydosa Using Olive-Mill Wastewater

Short introductive summary:

Olive oil industry is one of the most important industries in the world. Many environmental problems occur from that industry because of the production of huge amounts of wastewater since this by-product is characterized by a high inorganic and organic load. Organic substances found in olive-mill wastewater (OMWW) include sugars, phenolic compounds, polyalcohols, pectins, and lipids. This wastewater can be used as nutrients to produce an algal biomass with a biochemical composition rich in lipids. The use of microalgae to treat OMWW, remove carbon dioxide, and produce biomass as sustainable sources (like biofuels) is a practical option.

**Presenter:** **Sebastián SÁNCHEZ VILLASCLARAS, University of Jaén, Chemical Engineering, Environmental and Materials Dpt., Jaén, SPAIN**

Presenter's biography:

Sebastián Sánchez is Professor of Chemical Engineering at the University of Jaén. His research interests are in the areas 'Use of Lignocellulose materials for Biofuels Production', and 'Tertiary Treatment of Wastewater and Microalgae Biotechnology'. Currently, he is Director 'CEA OLIVE GROVE'(Spain)

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Session reference: 1BV.8.37  
Subtopic: 1.4 Algae production systems  
Topic: 1. BIOMASS RESOURCES

**Cultivation of *Scenedesmus Obliquus* in Mixtures of Urban and Olive-Oil Mill Wastewaters for the Dual Application of Algal Biomass Production and Wastewater Treatment**

Short introductive summary:

Urban wastewaters (UW) are generated in large quantities as a combination of water and wastes from homes, commercial and industrial facilities. These wastewaters are rich in nitrogen and phosphorus compounds such as ammonium, nitrates and phosphates as well as organic compounds and pathogenic microorganisms. On the other hand, olive oil mill wastewater (OMW), generated during the extraction process of olive oil, is characterized by containing high concentrations of organic compounds as well as high chemical and biological oxygen demand. OMW composition is also characterized by sugars, mineral nutrients, lipids, etc. Although OMW have inhibitor microorganism compounds as phenolic compounds, this wastewater after pre-treatment can be used by microalgae (fundamentally chlorophyta microalgae) for biomass production. This biomass composition was proved to be rich in energetic compounds.

**Presenter:** **Sebastián SÁNCHEZ VILLASCLARAS, University of Jaén, Chemical Engineering, Environmental and Materials Dpt., Jaén, SPAIN**

Presenter's biography:

Sebastián Sánchez is Professor of Chemical Engineering at the University of Jaén. His research interests are in the areas 'Use of Lignocellulose materials for Biofuels Production', and 'Tertiary Treatment of Wastewater and Microalgae Biotechnology'. Currently, he is Director 'CEA OLIVE GROVE'(Spain)

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Session reference: 1BV.8.38

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## The Influence of Light Intensity and Photoperiod on the Growth and Lipid Content of Microalgae from Three Climates

Short introductive summary:

In order to determine the impact of the original climate on three microalgae of different light intensities on the growth rate and lipid content of three freshwater prokaryotic and eukaryotic strains isolated and identified from different habitats in Algeria ;Desmodesmus sp, Desmodesmus communis and Synechocystis salina KSU-AQ10Q-1 were studied in non-axenic cultures, under non nutrient limited conditions in close system. Experiments were performed to determine the growth rate ( $\mu$  max) over a range of three light intensities ;(300,900  $\mu$ mol photons  $m^{-2} s^{-1}$  ) at diurnal temperature 27°C and 11°C of dark cycle, and 120  $\mu$ mol photons  $m^{-2} s^{-1}$  at (12/12 h) with continuous temperature at 26°C as a standard adaptation culture conditions

Presenter: **Lydia HAMEL, MARBEC.IFREMER.University of Montpellier, Montpellier, Montpellier, FRANCE**

Presenter's biography:

Multidisciplinary scientist with a background in molecular biology,biochemistry, genetics , microbiology and algal cultivation .experienced on the identification,prospecting and biomass microalgae strains from (temperate and extremophiles) water environments and different biotopes.

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Session reference: 1CO.1.1

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## **Heterotrophic Cultivation of Chlorella Vulgaris at High Glucose Concentrations for The Production of Health-Promoting Food Additives**

Short introductive summary:

The work is about heterotrophic cultivation of the microalga *Chlorella vulgaris* in bioreactors, with the goal of using high glucose concentrations to obtain high cell densities. Of interest were the analysis of growth parameters during cultivation, such as analysis of the fatty acid spectrum of the cultivated strain.

Presenter: **Martin LESNIAK, Bioenergy2020+ GmbH, Bioconversion & Biogas Systems, Tulln, AUSTRIA**

Presenter's biography:

2010-2016/2018: studying biotechnology at univ. of applied sciences FH Campus Wien / univ. of natural resources and life sciences in Vienna

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2017 to date: Junior researcher at Bioenergy2020+ (research area bioconversion & biogas systems)

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Session reference: 1CO.1.2

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## **Microalgal Biomass from Pig Manure: Influence of Temperature, Light Supply and Organic Load on Composition**

Short introductive summary:

I am Dr. David Hernández. I work in the Technological Agricultural Institute of Castilla y León (Valladolid, Spain) in a post-doc position. I am specialized in microalgal growth using agroindustrial wastewater and livestock. The main target of my work is to valorize microalgal biomass for biofuel production (bioethanol, biodiesel or biogas) and for fish feed.

Presenter: **David HERNÁNDEZ, ITACyL, Treatment of Livestock and Agroindustrial Wastewater, Valladolid, SPAIN**

Presenter's biography:

My name is David Hernandez, I am Doctor in Environmental Chemical Engineering. Currently I am working in the Technological Agricultural Institute of Castilla y León (Valladolid, Spain) in a post-doc position. I am specialized in microalgal biomass production from different agroindustrial wastewater.

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Session reference: 1CO.1.3

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES



**Delineating the Halotolerance Mechanism of Scenedesmus Sp. by Integrated Omics Approach: Potential Implications for Biofuel Production**

Short introductive summary:

In recent years, the fresh water scarcity has increased from 69 % to 77 % along with tripling of the water withdrawals. Therefore, utilization of fresh water for cultivating microalgae for biofuel production is unlikely without causing sustainability crises at the large farm deployment envisioned; urging the use of saline waters for large scale deployment. This necessitates the understanding of halotolerance molecular mechanisms in microalgae for the development of genetic engineered halotolerant strains. Algal omics techniques comprising genomics, transcriptomics, proteomics, and metabolomics are essential to facilitate targeted metabolic engineering approaches which can enhance triacylglycerol (TAG) and carbohydrate accumulation. The present investigation aimed to study the metabolic flexibility using omics techniques (proteomics and metabolomics) complemented by RT-PCR of a novel halotolerant microalgal strain capable of growing in natural sea water salinity along with high carbohydrate and lipid accumulation. The insights obtained from this study will aid in unraveling metabolic changes occurring in a halotolerant microalgae in response to salinity.

Presenter: **Neha ARORA, Indian Institute of Technology, Roorkee, Biotechnology, Roorkee, INDIA**

Presenter's biography:

Miss Neha Arora is Research Scholar at Department of Biotechnology, Indian Institute of Technology, Roorkee, India. Her work focuses on bioprospecting of indigenous microalgae and role of omics (Transcriptomics, Proteomics, Metabolomics) to decipher the lipid augmenting pathways.

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Session reference: 1CO.1.4

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## How to Set Up Sustainable Algae Biorefineries - Learning from Algae-Based Nutraceuticals

Short introductive summary:

Algae cultivation has raised high hopes for a sustainable production of various bio-based products from seemingly abundant sunlight and CO<sub>2</sub>. A new generation of industrial scale algae facilities seeking to realise these potentials may come within reach soon due to enormous technological advances. Currently, many approaches are concentrating on high value algae compounds for use as nutraceuticals.

We have comprehensively analysed algae cultivation plants operational for decades and concrete plans for new algae biorefineries with focus on nutraceuticals for their impacts on global and local environment, economy and society. They cover many different algae strains, all production technologies including several variants of raceways and PBRs and whole value chains including harvesting, medium recycling, extraction, purification and utilities provision.

From these examples, many lessons can be learned. Several measures to make algae production and use more sustainable will be highlighted. Facts, data and figures will be displayed to underline their importance. Detailed discussion and presentation of the findings are complemented by conclusions and recommendations.

Presenter: **Guido REINHARDT, IFEU-Institut Heidelberg, Biomass & Food, Heidelberg, GERMANY**

Presenter's biography:

Dr. Guido Reinhardt is a member of the scientific board of IFEU-Institute for Energy and Environmental Research Heidelberg and a scientific director of the department "Sustainability of renewable energies and bio-based systems" with more than 25 years of professional experience in this topic.

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Session reference: 1CO.1.5

Subtopic: 1.4 Algae production systems

Topic: 1. BIOMASS RESOURCES

## Support Schemes and Measures Enabling the Use of Biomass for Energy in the EU

Short introductive summary:

This paper aims to produce an outlook on (i) support schemes in EU countries to promote biomass; (ii) administrative procedures to remove regulatory and non-regulatory barriers to the deployment of biomass; and (iii) measures taken to ensure the transmission and distribution of electricity produced from biomass improving the framework for bearing and sharing costs related to grid connection. This paper will provide a synthesis, a classification and a comparison of policies and instruments in place in EU countries for bioenergy sector based on the EU countries reporting under Renewable Energy Directive and existing literature.

**Presenter: Manjola BANJA, European Commission, JRC, Renewable and Energy Efficiency, Ispra, ITALY**

Presenter's biography:

Manjola Banja studied Chemical Engineering and obtained her PhD in Atmospheric Physics at Faculty of Natural Sciences, Tirana University. From 1990-2003 she worked as a scientific researcher in the field of air and water pollution at Hydrometeorological Institute, Academy of Sciences of Albania. From year 2003 till 2008 she was Deputy Director of Hydrometeorological Institute, Academy of Sciences of Albania being coordinator of many national projects in the field of hydrometeorology, air and water pollution. In 2011 she starts working as Seconded National Expert at Renewable Energy Unit of Institute for Energy and Transport, Joint Research Centre, European Commission. Since 2014 she is a Scientific/Technical Officer working at Energy Efficiency and Renewables Unit, Directorate for Energy, Transport and Climate, JRC, EC. She is working on monitoring of European Union progress in the development of renewable energy according to Renewable Energy Directive. She is involved in the JRC 'Scientific Support to the Danube Strategy' initiative, Bioenergy nexus cluster providing scientific analysis on bioenergy deployment in this region. She is author and co-author of peer review papers as well as papers published in proceedings of national and international conferences.

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Session reference: 4CO.2.1

Subtopic: 4.1 Market implementation, investments & financing

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Economic and Environmental Prospects of Biofuels in the European Transport Sector

Short introductive summary:

Decarbonization of the transport sector requires the transition from fossil to renewable energy sources. While electric vehicles may become a viable option for individual car traffic, at least aviation, shipping and heavy duty transportation will continue to rely on liquid fuels. Biofuels can replace a large share of fossil fuel in these sectors. However, the usage of biofuels within transportation is only reasonable with significantly reduced Greenhouse gas (GHG) emissions compared to fossil fuels and lower GHG abatement costs compared to other decarbonization technologies. A detailed discussion of biofuels prospects in Europe shall be presented. Different biofuel production paths are compared and analyzed in terms of technical potential, fuel costs, GHG footprint and GHG abatement costs. The following questions are addressed:

- What share of the European transportation energy consumption can be covered by biofuels?
- In which sector seem biofuels most realistic and most feasible and what type of biofuels are required?
- How compare biofuels GHG abatement potential and GHG abatement costs with other GHG reducing technologies?

Presenter: **Ralph-Uwe DIETRICH, German Aerospace Center, Institute of Engineering Thermodynamics, Stuttgart, GERMANY**

Presenter's biography:

1988-1992 Scientific coworker at the Academy of Sciences of the German Democratic Republic (GDR)  
 1992-2004 Projec Manager at different enterprises (SME and Fortune 500) of process and automation industry  
 2004-2014 Scientific coworker at the Clausthaler Umwelttechnik Institute (CUTEC-Institut GmbH)  
 since 2015 Research Area Manager Alternative Fuels at the Institute of Engineering Thermodynamics at the German Aerospace Center (DLR) in Stuttgart

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 4CO.2.2

Subtopic: 4.1 Market implementation, investments & financing

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Findings from a Multi-Criteria Decision Analysis of Biofuels and other Renewable Fuels for the Maritime Sector

Short introductive summary:

In order to reduce the environmental and climate impact of shipping, in the short and long term, the introduction of alternative fuels is required. There is a need for more knowledge on alternative marine fuels. For example, what is the potential role of biofuels as marine fuels in relation to other alternative options? This is also of interest for the biofuels development in general since the global sustainable biomass resource base is limited. The purpose of this study is to assess the future role of biofuels and other renewable fuels in the shipping sector. The study maps the prerequisites for different renewable marine fuels and includes more specifically a multi-criteria decision analysis of selected alternative marine fuels covering several types of biofuels. The multi-criteria analysis is performed with a panel of shipping sector related stakeholders. Preliminary findings indicate that the fuel ranking differ between different stakeholder groups. The values of authorities lead to renewable hydrogen and biofuels being ranked high whereas the values of ship owners lead to LNG (liquefied natural gas) and fossil based methanol in the top instead of renewable options.

Presenter: **Julia HANSSON, IVL Swedish Environmental Research Institute, Climate & Sustainable Cities, Göteborg, SWEDEN**

Presenter's biography:

Dr Julia Hansson at IVL Swedish Environmental Research Institute, Sweden aims to provide perspectives on future bioenergy use and trade and renewable fuels for transport in a European policy context using energy system and policy analysis.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 4CO.2.3

Subtopic: 4.1 Market implementation, investments & financing

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Assessing the Risk Appetite of EU Bioenergy and Unconventional Gas Shareholders on Regulatory Changes**

Short introductive summary:

This study aims at quantifying the financial risk aversion of investors to regulatory changes in the energy sector. The study focused on the reaction of both unconventional gas and bioenergy companies on policy announcements in the EU energy sector from the failure of Copenhagen summit until the US withdrawal of the Paris Agreement.

Presenter: **Dimitrios SIDIRAS, University of Piraeus, Industrial Management and Technology Dpt., Piraeus, GREECE**

Presenter's biography:

Prof. D. Sidiras, Dep. Industrial Management & Technology, Univ. Piraeus; 5-year diploma and PhD in chemical engineering, NTUA; Scopus: 48 publications, 690 citations, h-index=12; Google Scholar 93 publications, 1248 citations, h-index=14.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 4CO.2.4

Subtopic: 4.1 Market implementation, investments & financing

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Export of Regular and Torrefied Wood Pellets from Chile to Europe And Asia

Short introductive summary:

Chile is known for a strong forest industry based on 2.5 million ha of forest plantations. The harvest and processing of 44 million m<sup>3</sup> of roundwood leads to a biomass potential of more than 5 million tons of plantation and sawmill residues per year which could be utilized to produce wood pellets. However, Chilean pellet mills face a limited domestic demand of approximately 100.000 tons per year. As 60 % of the Chilean pulp and wood chips are shipped to diverse destinations in Asia and Europe, the export of wood pellets could offer an opportunity to utilize the potential of residual biomass. In this study, an economic assessment of the production and export of Chilean pellets is carried out. A simulation model is developed which covers the entire supply chain including pellet production, transportation and storage, port operations and maritime shipping. The model is applied to compare regular and torrefied pellets and different destination ports in Europe and Asia. The results indicate that torrefied pellets would be competitive with regular wood pellets in the considered target markets.

Presenter: **Tobias ZIMMER, Karlsruhe Institute of Technology (KIT), Institute for Industrial Production (IIP), Karlsruhe, GERMANY**

Presenter's biography:

I am a PhD student at the Institute for Industrial Production (IIP) at the Karlsruhe Institute of Technology (KIT). In my research, I focus on supply chain aspects related to bioenergy production. I am currently working in a Chilean-German project about the biomass market in south-central Chile.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 4CO.2.5

Subtopic: 4.1 Market implementation, investments & financing

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Techno-Economic Assessment and Comparison of Biomass Pre-Treatment Processes in a BTL Chain. Application to Torrefaction and Pyrolysis**

Short introductive summary:

The goal of the present study is, first of all, to compare the processes of production of torrefied biomass and pyrolysis oil or pyrolysis slurry. The comparison is based on energy efficiency, mass efficiency and economic performance.

In a second step, we will focus on the production of synthetic fuels such as BtL fuels (Biomass to Liquid fuels), using torrefied biomass or pyrolysis oils as intermediates.

Note : the chosen topic is 3.1. Topic 3.2 or 3.6 may be possible.

Presenter: **Guillaume BOISSONNET, Commissariat à l'Energie Atomique, Biomass Project, Grenoble, FRANCE**

Presenter's biography:

Involved in Biomass systems evaluation since 2000.

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Co-authors:

G. BOISSONNET, CEA, Grenoble, FRANCE

Session reference: 3CO.3.1

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## **Improving Energetic and Material Efficiency by Hydrothermal Carbonisation of Sewage Sludge; a Parametric Study**

Short introductive summary:

The research goal is the description and understanding of the chemical and energetic impact of the Hydrothermal Carbonisation (HTC) on sewage sludge. One major focus is on the Phosphorous bonding during the process in the solid and in the liquid phase. A significant improvement of the process understanding enables the evaluation and comparison of different process configurations. Several different parameters are investigated during laboratory experiments Especially a CO<sub>2</sub> treatment, recirculation of process water und high temperature phase separation offer promising advances for the HTC process. Based on the experimental results an elementary balancing of the relevant organic and inorganic components is carried out and a unified model describing the HTC of sewage sludge will be developed. Those results contribute a better fundamental understanding and give the opportunity for a more efficient HTC process design.

Presenter: **Wolfgang WALDMÜLLER, Technical University of Munich, Associate Professorship of Regenerative Energy Systems, Straubing, GERMANY**

Presenter's biography:

since 2015: Research associate at Technical University of Munich, Germany

2011-2014: Master' s dregree study "Technical chemistry - chemical process technology"

2008-2011: Bachelor' s dregree study "Chemical and biological engineering"

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Session reference: 3CO.3.2

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **The Influence of Metals and Heteroatoms on Process Chemistry during the Hydrothermal Carbonisation of Biomass**

Short introductive summary:

Understanding the roles of metals is becoming increasingly important especially when looking to produce both fuels and platform chemicals from biomass. For this work miscanthus and a series of model compounds has undergone hydrothermal carbonisation and the influence these metals have had on char formation and process water chemistry assessed using a range of different analytical techniques.

Presenter: **Aidan SMITH, University of Aarhus, Energy Research Institute, DENMARK**

Presenter's biography:

I am final year PhD student at Leeds University. My research looks into the fate and influence of inorganics and heteroatoms during hydrothermal carbonisation of biomass. Prior the PhD I spent six years working on environmental issues associated the mining and renewable energy sector.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

Co-authors:

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Session reference: 3CO.3.3

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Hydrothermal Carbonization and Activation of Lignin-Rich Ethanol Co-Product

Short introductive summary:

HTC of lignin from lignocellulosic ethanol production was performed in a lab-scale batch reactor. Experiments were carried out by varying reaction temperature and residence time, evaluating the effect of these parameters on the solid yield and on the char characteristics in terms of specific surface area, average pore diameter and total pore volume. In addition, the resulting aqueous phase were characterized by GC-MS and by GC-FID and HPLC. Subsequent physical and chemical char activation was performed in a tubular furnace respectively by means of CO<sub>2</sub> and KOH. The structural characteristics of the activated char were then analysed and compared.

Presenter: **Edoardo MILIOTTI, University of Florence, CREAR/RE-CORD, Prato, ITALY**

Presenter's biography:

Phd student at industrial engineering department of University of Florence; working at RE-CORD consortium on hydrothermal conversion processes.

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Session reference: 3CO.3.4

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **How to Convert the European Underexploited Biomass Side Streams into Marketable Products: an Extensive Study of Suitability Feedstock/Process/Product up to Pilot Scale**

Short introductive summary:

Europe has a large potential of underexploited agro- and forest biomass side streams, mainly because of their diversity, seasonality and dispersion. The MOBILE FLIP project aims to solve this issue through the demonstration of flexible and mobile units of conversion based on several advanced processes – pelletizing, torrefaction, slow pyrolysis, hydrothermal carbonization, hydrothermal treatment before saccharification – and giving rise to various products, like energy carriers for combustion, particle board manufacturing, soil amendment and chemicals.

To achieve this goal, one major task is to evaluate suitability between the biomass available, the processes and the targeted products and then to optimize process operating conditions. In the present study, more than 15 of the most abundant biomass resources in Europe were therefore extensively characterized and tested in several laboratory and pilot scale units to supply data for the demonstration units operation.

**Presenter: Capucine DUPONT, IHE Delft Institute for Water Education, Delft, THE NETHERLANDS**

Presenter's biography:

Dr. Capucine Dupont is Lecturer-Researcher in Solid Waste Management in IHE Delft Institute for Water Education (the Netherlands). Her research work mainly focuses on the production of thermally treated solid and its applications with specific interest on suitability feedstock/process/product.

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Session reference: 3CO.3.5

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Biogas Power Plants for Deterministic Power Generation

Short introductive summary:

With the expansion of renewable but volatile power generation from wind and solar energy, the demand for future energy system management is increasing. Especially the security and reliability of electricity supply has to be evaluated with new focuses. To ensure grid stability controllable energy producers are required. The expansion of technical and economic potential of controllable power production via biogas plants enables grid stability in the future. In this context the Technische Hochschule Ingolstadt is working on the research project "FlexFuture – Integration of biogas plants in electricity grids with a high share of installed variable power producers". Concepts are generated and simulations are carried out regarding modifications for a controllable electricity production via biogas plants. Special focus is on the CHP units, the heat supply for internal and external heat demands, the combination of PV power plants and a biogas plant at one grid. The overall efficiency of biogas plants is optimised, while a monitoring system and a proactive control unit is implemented in a flexible biogas plant.

Presenter: **Katharina BÄR, Technische Hochschule Ingolstadt, Institute of New Energy Systems, Ingolstadt, GERMANY**

Presenter's biography:

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October 2015 – now

Research Engineer

(Focus on Optimising the Flexible Electricity

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Education :

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*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 5CO.4.1

Subtopic: 5.2 Technological options for energy grid balancing

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

## **The Role of Biomass in the Future Development of CSP in Southern Europe: the Case of Spain**

Short introductive summary:

There are different alternatives in current CSP-based plants for energy storage (e.g. molten salts) and also natural gas support is widely used for starting periods or bad weather conditions. However, these technologies are insufficient to ensure future penetration of CSP into a de-carbonized grid. To balance CSP generation in such a scenario, e.g., during periods of peak demand or nights and cloudy days, different technologies have been proposed. In this study, the use of biomass gasifiers coupled with energy storage devices are analyzed. The objective is to know the level of balancing that CSP plants would require in order to be able to satisfy fluctuating electricity demands on a decarbonized grid.

Presenter: **Pedro HARO, Universidad de Sevilla, Chemical and Environmental Engineering, Seville, SPAIN**

Presenter's biography:

Pedro Haro is a post-doc researcher at the Bioenergy Group since 2015. His main research topic is the design and assessment of thermochemical biorefineries and waste-energy systems. He has collaborated with several research centers for the evaluation of pre-commercial and demonstration projects.

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Session reference: 5CO.4.2

Subtopic: 5.2 Technological options for energy grid balancing

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

## **Development of Operation Schedules for Demand-Orientated Power Generation of Biogas Chp Units**

Short introductive summary:

In the present study schedules for a demand driven operation of biogas CHP units were developed. The main method used was an ex-post analysis using market data from the intraday market and the market for secondary balancing power.

Presenter: **Josef WALCH, University of Applied Sciences Wiener Neustadt, Wieselburg, AUSTRIA**

Presenter's biography:

Josef Walch is a lecture and researcher specializing in renewable energy at the University of Applied Science Wiener Neustadt Campus Wieselburg. His extensive work experience in agriculture and forestry has helped give him an insight into opportunities offered by sustainable energy systems.

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Session reference: 5CO.4.3

Subtopic: 5.2 Technological options for energy grid balancing

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

## **Evaluation of Suitable Storage Devices for Flexible Biomass Combustion Plants**

Short introductive summary:

B.Eng Matthias Stark

Employed at: Institute of New Energy Systems (THI), Ingolstadt April 2014-now Research Engineer

Writing Phd about "Steam Storage for flexible Biomass power generation"

Eta Energy Consulting, Pfaffenhofen, Feb 2011-March 2014 Project Engineer

Education: THI, Mechanical Engineering, B.Eng.

Presenter: **Matthias STARK, Technische Hochschule Ingolstadt, Institute of new Energy Systems, Ingolstadt, GERMANY**

Presenter's biography:

B.Eng Matthias Stark

Employed at: Institute of New Energy Systems (THI), Ingolstadt April 2014-now Research Engineer

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Session reference: 5CO.4.4

Subtopic: 5.2 Technological options for energy grid balancing

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS



## The Role of Biomass for Small District Heating Grids for South-Eastern Europe - The Coolheating Project

Short introductive summary:

The objective of the CoolHeating project, funded by the EU's Horizon2020 programme, is to support the implementation of "small modular renewable heating and cooling grids" for communities in South-Eastern Europe. This is achieved through knowledge transfer and mutual activities of partners in countries where renewable district heating and cooling examples exist (Austria, Denmark, Germany) and in countries which have less development (Croatia, Slovenia, Macedonia, Serbia, Bosnia-Herzegovina). Core activities, besides techno-economical assessments, include measures to stimulate the interest of communities and citizens to set-up renewable district heating systems as well as the capacity building about financing and business models. The outcome is the initiation of new small renewable district heating and cooling grids in 5 target communities up to the investment stage. These lighthouse projects will have a long-term impact on the development of "small modular renewable heating and cooling grids" at the national levels in the target countries.

Presenter: **Dominik RUTZ, WIP Renewable Energies, Unit Bioenergy & Bioeconomy, München, GERMANY**

Presenter's biography:

Dominik Rutz is a Senior Project Manager at WIP Renewable Energies ( [www.wip-munich.de](http://www.wip-munich.de)) since 2005. He graduated in Environmental Science (Dipl.-Ing.) and Consumer Science (M.Sc.). His main field of experience includes the technical and non-technical analysis of bioenergy and its supporting policies in developing countries and emerging economies worldwide. He is coordinator of several EU funded projects.

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Session reference: 5CO.4.5

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

## **"Mediterranean" Solid Biofuels from Agro-Industrial Residues in Greece: Market Status and Prospectives for the Domestic Heating Sector**

Short introductive summary:

The paper focuses on the biomass streams produced from two agro-industrial sectors in Greece: olive oil processing and nut crushing plants. Both can produce high quality fuels which can be used for domestic heating applications. The fuel quality is dependent on the technologies implemented - especially for the olive processing sector - and can be improved compared to current conditions. The paper aims to present the current situation in the market, as well as the future potential based on statistical data sources, interviews with market actors and fuel analysis results.

Presenter: **Emmanouil KARAMPINIS, Centre for Research and Technology Hellas, Chemical Process and Energy Resources Institute, Marousi, Athens, GREECE**

Presenter's biography:

MSc. Chemical Engineer. Research Associate at Centre for Research and Technology Hellas (CERTH) since 2006. Research areas include thermochemical conversion systems for solid biofuels, biomass co-firing, biomass logistics and sustainability assessment.

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Session reference: ICV.1.1

Subtopic: 6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)

Topic: 6. INDUSTRY SESSIONS

## **New Salix Dasyclados and Populus X Woobsti Clones Selected in Latvia for Multi Functional Use**

Short introductive summary:

Clones were presented at IPS in Berlin 2016, No research papers about productivity published yet.

Research activities were supported by three European Rural Development Fund projects

“Elaboration of models for establishment and management of multifunctional plantations of short rotation energy crops and deciduous trees” No

2010/0268/2DP/2.1.1.1.0/10/APIA/VIAA/118 (2010-2013), “Developing the methods of

plantation cultivation of fast-growing forest crops and evaluating the suitability of their wood

for pelletizing” No 2013/0049/2DP/2.1.1.2.0/13/APIA/VIAA/031 (), “Elaboration of

technologies of fast growing tree species vegetative propagated clones identification” No

2014/0025/2DP/2.1.1.1.0/14/APIA/VIA/101 .

Promoting of clones and future test are supported by project 14-07-17: EU research

project MAGIC – Marginal Lands for Growing Industrial Crops: Turning a burden into an

opportunity

Presenter: **Dagnija LAZDINA, LSFRI Silava, Forest regeneration and establishment, Salaspils, LATVIA**

Presenter's biography:

Education:Latvian University of Agriculture, Forestry Faculty, Latvia 2005-2008 Doctoral Studies Doctor of Forestry

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Session reference: ICV.1.4

Subtopic: 6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)

Topic: 6. INDUSTRY SESSIONS

## **Finding Robust Strategies to Overcome Biomass Supply Risks**

Short introductive summary:

The aim of this paper is to develop and evaluate innovative strategies in order to overcome biomass supply problems and to increase the competitiveness of bioenergy production. Potential impacts of the socio-economic, political and ecological environment on future demand and the supply situation are scanned by means of portfolio and risk analyses. Based on a SWOT- strategy development process preventative and coping strategies are formulated. A holistic evaluation of the developed strategies by stakeholders of the whole biomass supply chain, including competing industries (i.e. bioenergy, pulp and panel industry) is performed by applying a standardized group decision process. The proposed strategy development process and the portfolio of the top ranked strategies facilitate both; the wood based bioenergy production in increasing supply security, and further research focusing on strategic issues of the biomass supply chain. The portfolio of the top ranked strategies assists bioenergy stakeholders (e.g. investors, feedstock procurement managers and government agencies) in making strategic decisions with regard to investment, biomass supply and policy.

Presenter: **Peter RAUCH, University of Natural Resources and Life Sciences, Vienna, AUSTRIA**

Presenter's biography:

Dr. Peter Rauch is working as private docent at the University of Natural Resources and Life Sciences, Vienna since 2002. His research focuses on strategic biomass procurement planning, supply chain optimization and supply chain risks.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

Co-authors:

PR Rauch, BOKU, Vienna, AUSTRIA

Session reference: ICV.1.7

Subtopic: 6.5 Policy

Topic: 6. INDUSTRY SESSIONS

## Is Bio-Fossil Fuel a Thing?

Short introductive summary:

Following the COP21 conference, many countries including Canada have made strong commitments towards reduction of GHG emissions. At the same time, natural gas exploitation is constantly expanding hence leading to potentially more emissions in the upcoming years, being one of the cheapest source of energy on the planet at this point as well as being a potential candidate to replace oil in a long term perspective. However, carbon taxes have provided new opportunities for greener technologies such as dry reforming and in this will be reported how such process could be used to simultaneously reduce the carbon footprint of natural gas (up to 75%) while allowing the sequestration of CO<sub>2</sub> and storage of green electricity through chemistry and eventually added value products. Most importantly, with the actual carbon market, such technology, which used to be struggling with classical reforming technologies such as steam methane reforming or partial oxidation of methane (POX) may become economically deployable in an industrial context.

Presenter: **Jean-Michel LAVOIE, Université de Sherbrooke, Chemical Engineering Dpt., Sherbrooke, CANADA**

Presenter's biography:

Pr Jean-Michel Lavoie is the Chairholder of the Industrial Research Chair on Cellulosic Ethanol and Biocommodities (CRIEc-B) at the Université de Sherbrooke as well as leader of the Thermochemical Biorefinery Task Force and the Gasification project in the BioFuelNet network.

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Session reference: ICV.1.9

Subtopic: 6.5 Policy

Topic: 6. INDUSTRY SESSIONS

## Development of a Sustainable European Bioeconomy - The Contribution of the Bbi Demonstration Project Grace

Short introductive summary:

The European Bioeconomy sector is expected to grow in the up-coming decade, since large investments in R&D and industrial facilities are currently made. However, a growing Bioeconomy needs a reliable and cost-efficient supply of sustainable produced biomass. To secure the biomass supply, a market for sustainable-produced biomass needs to be established and the value chains need to be well organized.

The BBI demonstration project GRACE, with a total budget of 15 million €, was set up to tackle both: create a market for sustainably-produced biomass by matching the biomass crops miscanthus and hemp to specific utilization options and to develop value chains by cross-sector connection of farmers, industry and SME's. To achieve this, GRACE will demonstrate the feasibility and sustainability of 10 novel, hemp- and miscanthus-based value chains and establish more than 80 ha of new demonstration field across Europe. In GRACE, a unique cross-sector consortium of 22 partners from academia, industry, SME's, farmers and an industry cluster join forces to secure the biomass supply of a growing bioeconomy with regionally and sustainably-produced biomass.

Presenter: **Andreas KIESEL, University of Hohenheim, Biobased Products and Energy Crops, Stuttgart, GERMANY**

Presenter's biography:

Andreas Kiesel is Scientist at the Institute of Crop Science, Dpt. Biobased Products and Energy Crops. His field of research is novel application options of miscanthus. He started his career in the EU project OPTIMISC (289159) and is now coordinating the H2020 BBI Demo project GRACE (745012).

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Session reference: ICV.1.10

Subtopic: 6.5 Policy

Topic: 6. INDUSTRY SESSIONS

## **Denmark Bioethanol Project Plan Analysis of Three Different Raw Materials**

Short introductive summary:

If unable to reduce the volume of halm, the physical facilities and other supports needed for halm bioethanolfabrik, such as process equipment, plant plot area, employee number, and investment amount, etc., shall be 7 times of 60 000t wheat bioethanolfabrik. Unit energy consumption of Halm bioethanolfabrik shall be far higher than that of wheat bioethanolfabrik, and this will be discussed in a separate paper.

Halm is not suitable for the production of bioethanol. It is suggested that halm is made into pellet fuel, stalk juice into bioethanol or bio aviation fuels.

Presenter: **Yangsheng LU, International Starch Institute, Aarhus, DENMARK**

Presenter's biography:

Ren.assistent/Engineer, Dalian University of Technology, China/International Starch Institute, 8200 Aarhus Denmark.

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Session reference: ICV.1.11

Subtopic: 6.5 Policy

Topic: 6. INDUSTRY SESSIONS

## **A Small-scale ESP for Reduction of Particulate Matter emissions from Residential Wood Stoves**

Short introductive summary:

A collaborative project is running in academia and industry to develop a small-scale ESP for reduction of particulate matter from combustion of wood. The product was designed, tested and characterized for residential wood stoves.

Presenter: **Syednezamaddin AZIZADDINI, DTU, Chemical Engineering, Kgs. Lyngby, DENMARK**

Presenter's biography:

I Have done my PhD at the Department of Chemical Engineering at DTU (Denmark) on the subject of fluidization and power handling. Since June 2016, I have been working on an industrial postdoc project for development of a small-scale ESP to be applied for residential wood stoves.

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Session reference: ICV.1.13

Subtopic: 6.5 Policy

Topic: 6. INDUSTRY SESSIONS



## **The Environmental Impact of Bioenergy for Residential Heating: Life Cycle Assessment (LCA) of Renewable Heating with Pyrolysis Oil from Five Different Biomass Feedstocks**

Short introductive summary:

In this study, the full impact of pyrolysis oil for residential heating is determined, using the methodology of a Life Cycle Assessment (LCA). The entire process chain, from biomass production to the generation of residential heat, is investigated. The resulting impacts are calculated using ReCiPe2016 and compared to those of current fossil methods (heating with natural gas and light fuel oil) and a bioenergy alternative (heating with wood pellets). Moreover, five different pyrolysis feedstocks are investigated in order to determine the value chain with the lowest environmental impact.

Presenter: **Jurjen SPEKREIJSE, BTG Biomass Technology Group, Enschede, THE NETHERLANDS**

Presenter's biography:

Jurjen Spekrijse worked as a PhD at Wageningen University, the Netherlands and as post-doc at Chalmers University, Sweden, both in the field of biobased chemistry. In 2017 he started at BTG Biomass Technology Group, where one of his main responsibilities are conducting life cycle assessments (LCAs)

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Session reference: ICV.1.14

Subtopic: 6.5 Policy

Topic: 6. INDUSTRY SESSIONS

## GHG-Emissions of Rapeseed Oil Fuel - Impact of Specific Data and Balance Methods

Short introductive summary:

In the regard of climate and resource protection the production and use of decentralized rapeseed oil fuel offers a great potential, especially for reducing GHG-emissions in the agricultural and forestry sector. To assess this potential a profound knowledge about how to calculate and to avoid GHG emissions is necessary. In this work regional and farm-specific greenhouse gas balances are carried out for the production of rapeseed and rapeseed oil fuel. The analysis and assessments are based on specific data of 36 agricultural farms located within six different soil-climate-areas of Bavaria, Germany over four years. The balance results of rapeseed production show a considerable variation of GHG-emissions. This range results from nitrogen-efficiencies and the type of N-fertilizer, which are used. The farm-specific data illustrate that manure or fermentation residues are often applied excessively in addition to mineral N-fertilizers. These specific data are not considered in default values, specified in the Directive 2009/28/EC. That's why default values are not suitable to identify optimization potentials and to derive recommendations for action.

Presenter: **Daniela DRESSLER, Technology and Support Centre in the Centre of Excellence for Renewable Resources, Liquid Biofuels, Biolubricants and Process Materials, Straubing, GERMANY**

Presenter's biography:

Dr.-Ing. Daniela Dressler

Research associate

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Sustainability: Head of working area, project management

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Session reference: ICV.1.15

Subtopic: 6.5 Policy

Topic: 6. INDUSTRY SESSIONS

## **Application of Herbaceous Biomass Obtained from Landscape Management for Generation of Biogas Energy**

Short introductive summary:

The overall objective of Horizon-2020 funded greenGain ([www.greengain.eu](http://www.greengain.eu)) project is to suggest optimum pathways strengthening the energetic utilisation of biomass from landscape conservation and maintenance works (LCMW). As a part of project work, this study presents the business case for the application of LCMW grass as a co-substrate to biogas plants. The idea behind targets the utilization of the grass to produce energy with reduced investments on substrate costs by biogas plant operators.

Presenter: **Klaus LENZ, Syncom F&E Beratung, Research & Development Consulting, Ganderkesee, GERMANY**

Presenter's biography:

Dr. rer. nat. Klaus Lenz, received a PhD in physics from the Rheinische Friedrich Wilhelms University in Bonn, Germany in 1987. He is the managing director of the innovation consulting firm SYNCOM.

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Session reference: ICV.1.17

Subtopic: 6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)

Topic: 6. INDUSTRY SESSIONS

## **Business Opportunities in Subcontracting of Landscape Management Activities**

Short introductive summary:

The overall objective of the H2020-funded EC-project greenGain ([www.greengain.eu](http://www.greengain.eu)) is to support the energetic utilisation of biomass from various landscape management activities carried out in the public interest across Europe. This study presents business opportunities in subcontracting of landscape management activities. Specialized companies can perform these operations with highly efficient equipment and optimised processes leading to lower production costs and a higher fuel quality. With dedicated equipment and optimised processes wood chips and grass from landscape management activities can be produced at competitive rates if the avoided costs for the base land management process are taken into account.

Presenter: **Klaus LENZ, Syncom F&E Beratung, Research & Development Consulting, Ganderkesee, GERMANY**

Presenter's biography:

Dr. rer. nat. Klaus Lenz, received a PhD in physics from the Rheinische Friedrich Wilhelms University in Bonn, Germany in 1987. He is the managing director of the innovation consulting firm SYNCOM.

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Session reference: ICV.1.18

Subtopic: 6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)

Topic: 6. INDUSTRY SESSIONS

## **Experimental and Numerical Approach to Improve the Performance of a Small Chp Wood Gasification Plant**

Short introductive summary:

The present work shows the application of an experimental and numerical methodology aimed to study how the gasifier setting influences the reciprocating internal combustion engine (RICE) performances. Using a kinetic model, implemented in the Aspen Plus ® commercial code, the syngas production and composition of a wood downdraft gasifier has been predicted varying equivalence ratio and gasification air temperature. After that, the influence of syngas composition on RICE performances has been analysed using the dedicated AVL Boost® commercial code. Both models have been previously tuned using experimental data obtained from a commercial scale wood gasification CHP plant.

Presenter: **Stefano FRIGO, University of Pisa, Energy, Systems, Territory and Costruction Engineering Dpt., Pisa, ITALY**

Presenter's biography:

Stefano Frigo took a Bachelor in Mechanical Engineering in 1991 and a Ph.D. in Energetic at the University of Genoa in 1994. From 1998 he works at the University of Pisa carrying on research activities concerning internal combustion engines and biomass utilization in cogeneration power plants.

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Session reference: 2CV.2.1

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Effect of Feedstock Concentration on Supercritical Water Gasification of Guaiacol

Short introductive summary:

Supercritical water gasification is gasification of biomass in hot compressed water whose temperature and pressure are above critical values of water. Effect of feedstock concentration is known to affect the gasification efficiency, which is not usual for conventional gasification. In this study, feedstock concentration was changed for supercritical water gasification of guaiacol, model compound of lignin. TOC yield was not affected, but solid production increased with concentration.

Presenter: **Nattacha PAKSUNG, Hiroshima University, Department of Mechanical Science and Engineering, Hiroshima, JAPAN**

Presenter's biography:

Postdoctoral researcher at Thermal Engineering Laboratory, Department of Mechanical Science and Engineering, Hiroshima University, Japan. Her research interest is hydrothermal conversion of biomass.

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Session reference: 2CV.2.2

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Assessment of Four Ways of Gas Purification by Biomass Gasification

Short introductive summary:

The article deals with methods of eliminating tar from the gas obtained from biomass gasification. Gasification is a thermochemical process which transforms solid fuel into a combustible gas. This gas is subsequently used in energy plants for production of electric and thermal energy. The end-use of the gas is, however, limited by impurities which contaminate the gas generated. There are numerous methods for cleaning gas from the unwanted admixtures, this article compares the wet scrubbing method and the method of using natural or metal catalysts. The article presents theoretical principles of all the methods and their advantages and disadvantages. In the conclusion are these methods assessed according to the results of the experiment on a real device.

Presenter: **Marek BALAS, Brno University of Technology, Energy Department, Brno, CZECH REPUBLIC**

Presenter's biography:

A researcher in the field of energy, biomass, combustion and gasification on Brno University of Technology in Czech Republic.

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Session reference: 2CV.2.3

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Chemically Enhanced Biochar for Syngas Filtering Purposes

Short introductive summary:

This paper describes the modification and characterization of biochar for its use as a secondary filter media and its comparison with the unmodified one. Gasification biochar extracted from an All Power Labs PP20 gasifier was treated in 4 different ways and the behaviour as syngas filtering media was assessed for each treated sample.

Presenter: **Simone PEDRAZZI, University of Modena and Reggio Emilia, of Engineering "Enzo Ferrari" - Bio Energy Efficiency Laboratory (BEELAB), Modena, ITALY**

Presenter's biography:

Simone holds M.Sc. and Ph.D. degrees in Mechanical Engineer at the University of Modena and Reggio Emilia. He works as teaching assistant at the University of Modena and Reggio Emilia and he is a co-founder of the Bio Energy Efficiency Lab (BEELab).

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Session reference: 2CV.2.7

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



## **Assessment of a Novel Biomass-Coal Gasification-Based System for Hydrogen and Power Co-Generation Integrated with Chemical Looping Technology**

Short introductive summary:

The system evaluated in this study integrates two chemical looping processes, namely, one designed for hydrogen production and conversion of biomass/coal-derived syngas using a three-reactor chemical looping hydrogen generation process and another one for oxygen production using a two-reactor chemical looping air separation process.

Presenter: **Ioana IONEL, Universitatea Politehnica Timisoara, Mechanical Engineering Dpt., Timisoara, ROMANIA**

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Session reference: 2CV.2.9

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Thermal Degradation and Tar Removal Potential of Biomass Char from Commercial Gasifiers**

Short introductive summary:

Tar formation is one of the main obstacles for the development of biomass gasification technologies. It is harmful to equipment and a hindrance to clean fuel production. Recently, the use of char as catalyst or as catalyst support for tar cracking applications has been intensively studied. The present work investigates the use of char obtained from commercial gasification systems as adsorbent and as catalyst for the removal of tars. First, thermal degradation tests were carried out to verify the suitability of char for high temperature applications, like the ones that are required for the cracking of tar molecules. Then, tar adsorption and catalytic tests were performed in a fixed-bed reactor. Toluene was chosen as model tar compound, but further experiments are envisaged with other synthetic compounds and with real producer gas. The performance of char samples was evaluated in terms of tar removal efficiency based on inlet and outlet concentrations of toluene. Results proved that biomass char has great potential for adsorptive and catalytic removal of gasification tars.

Presenter: **Eleonora CORDIOLI, Free University of Bolzano, Faculty of Science and Technology, Bolzano, ITALY**

Presenter's biography:

Eleonora Cordioli is a recent graduate in Energy Engineering from Free University of Bolzano (Italy). She is dedicated to the study of biomass gasification processes, and, in particular, to the utilization of char as a catalytic gas filtering medium for tar cracking.

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Session reference: 2CV.2.15

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Waste Gasification for Power Generation: Assessment of Industrial and Non-Industrial Alkaline Residues as Sorbents for Acid Gas Removal**

Short introductive summary:

In this work, a survey on potentially appropriate residues is conducted, with the main objective of establishing their sustainability as a sorbent to clean acid species in a gasification-derived gas produced from dirty biomass or urban residues. Furthermore, this work presents a classification based on their potential in sulfur and chlorine abatement using state of the art technologies.

Presenter: **Pedro HARO, Universidad de Sevilla, Chemical and Environmental Engineering, Seville, SPAIN**

Presenter's biography:

Pedro Haro is a post-doc researcher at the Bioenergy Group since 2015. His main research topic is the design and assessment of thermochemical biorefineries and waste-energy systems. He has collaborated with several research centers for the evaluation of pre-commercial and demonstration projects.

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Session reference: 2CV.2.16

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Biosyngas for Electricity Generation Using Fuel Cells - A Gas Quality Assessment

Short introductive summary:

Coupling of a high efficiency energy conversion device with a fuel obtained from a renewable energy source facilitates stand-alone clean power generation. Gasification is a thermo-chemical process which can produce a gaseous fuel called syngas. Solid oxide fuel cell is a fuel flexible, highly efficient energy conversion device with low emissions, which can be coupled with gasification systems for decentralized power generation. Researchers have reported that tar - a major component present in the syngas, can cause degradation of solid oxide fuel cell anodes. In the present study, quantitative and qualitative analysis of tar present in the hydrogen-rich syngas obtained from an oxy-steam, fixed bed downdraft gasification system developed at Indian Institute of Science, Bangalore was assessed and compared with that of other systems.

Presenter: **Rakesh N, Indian Institute of Science, Bangalore, Centre for Sustainable Technologies, Bangalore, INDIA**

Presenter's biography:

I am a Research student at the Centre for Sustainable Technologies, Indian Institute of Science, Bangalore. I am working on the operation of solid oxide fuel cells with biomass derived syngas.

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Session reference: 2CV.2.17

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Modelling of a 3 MWth BFB Gasifier in AspenPlus™

Short introductive summary:

The installation consists of a 3 MWth atmospheric, air-blown BFB gasifier which can operate with various fuel types, namely biomass chips and pellets.

The model for the prediction of syngas quality is a steady-state model based on thermodynamic equilibrium by Gibbs free energy minimization. Firstly all basic components are defined in the Components section of the software. For these runs, the compounds defined are N<sub>2</sub>, O<sub>2</sub>, C, S, H<sub>2</sub>, CO, CO<sub>2</sub>, CH<sub>4</sub>, H<sub>2</sub>O, H<sub>2</sub>S, SO<sub>2</sub>, SO<sub>3</sub>, COS, HCN, C<sub>2</sub>H<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>6</sub>H<sub>6</sub>, C<sub>10</sub>H<sub>8</sub>, as well as biomass and ash.

Presenter: **Kyriakos PANOPOULOS, Centre for Research & Technology Hellas, Chemical Process & Energy Resources Institute, Thessaloniki, GREECE**

Presenter's biography:

Dr. Kyriakos D. Panopoulos is currently a researcher Centre for Research and Technology Hellas/ Chemical Process and Energy Resources Institut. He currently leads a research group on the fields of gasification and biofuel production.

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Session reference: 2CV.2.18

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Gasification and Wine Industry: Report on the Use Vine Pruning as Fuel in Small-Scale Gasifiers

Short introductive summary:

This work is aimed at demonstrating the possibility to use vine pruning as fuel for distributed power production. 11 type of vine pruning were tested in a 20kW gasifier. Specific consumption as well as quality of the gas were monitored. The results show that, with a proper preparation of the fuel, this resource can produce tremendous amount of energy.

Presenter: **Nicolò MORSELLI, Università degli Studi di Modena e Reggio Emilia, Carpi, ITALY**

Presenter's biography:

I am currently enrolled with a scholarship in the PhD in Industrial and Environmental Engineering.

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Session reference: 2CV.2.19

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Fate of Radioactive Caesium During Woody Biomass Gasification

Short introductive summary:

Due to the Fukushima Daiichi Nuclear Power Plant accident occurred in 2011, radioactive caesium was dispersed over a wide range of eastern Japan including forest area. Gasification of the woody biomass may cause radioactive caesium volatilisation, triggering condensation or scattering at a higher temperature. However, much remains unclear about the behaviour of radioactive caesium during gasification process. Therefore, the goal of this research is to reveal the behaviour of radioactive caesium during gasification for safe biomass use. Through an operation of a laboratory scale gasifier, the behaviours are measured in various gasification conditions. As a result, it is revealed that radioactive caesium vaporised at the higher reaction temperature ( $T = 1000^{\circ}\text{C}$ ), and that the vaporised caesium increases with increasing S/C ratio at  $T = 1000^{\circ}\text{C}$ .

Presenter: **Kenji KOIDO, Fukushima University, Faculty of Symbiotic Systems Science, Fukushima, JAPAN**

Presenter's biography:

Dr. Kenji Koido is an Associate Professor at Fukushima University. He earned Ph.D. in Engineering from Nagoya University. He started the research about biomass gasification at BTRC, AIST. He continues the investigation at Tokyo University of Science followed by Fukushima University.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 2CV.2.21

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Gasification Based Synchronized Production of Fuels and Electricity from Woody Biomass - A Techno-Economic Analysis

Short introductive summary:

A gasification system for the production of liquid fuels via Fischer Tropsch (FT) synthesis and generation of hydrogen from woody biomass is considered, with electricity as a valuable by-product. An overview of the mass and energy conversion are provided for the biomass to liquid fuel (BTL) and hydrogen production. The cost analysis is based on the annualized life cycle of the systems that include oxygen-steam biomass gasifier coupled to a FT unit and an alternative process of the gasification system coupled to a H<sub>2</sub> separation unit. For the production of liquid fuels, a downdraft gasifier is considered. It is operated at an equivalence ratio of 0.1 and steam-to-biomass (SBR) ratio of 0.85 yielding syngas with H<sub>2</sub>/CO = 2.1:1. The overall mass and energy balance for the FT synthesis are considered for novel cobalt catalysts that predominantly yield liquid hydrocarbons and waxes. For the once-through FT synthesis, the study proposes utilization of product gas (C<sub>1</sub>-C<sub>5</sub> hydrocarbons and unconverted syngas) in IC engine for the co-production of electricity, for internal consumption and sale to the grid. Furthermore, the economics of H<sub>2</sub> production are analyzed for SBR of 0.85 and 1.5.

Presenter: **Stefano PIAZZI, Bolzano, ITALY**

Presenter's biography:

PhD student at Free University of Bolzano - Italy.

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Session reference: 2CV.2.22

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



## Cold Flow Video Analysis of Char Distribution in the Indirect Milena Gasifier

Short introductive summary:

Framed in the project KEVER (funded by the Netherlands Enterprise Agency), DRT and ECN conduct research aimed at reduction of cost and increase of efficiency of the MILENA gasifier and OLGA gas cleaning system, with the final goal of zero-waste-discharge.

Cold-flow modeling, computational analysis of video data and pilot-scale testing results will be presented to give insights of the effect of char recycling to the bubbling fluidized bed combustor of MILENA in terms of distribution, temperature and flue gas emissions.

Presenter: **Alexander GROOTJES, Energy Research Centre of the Netherlands, Bio Energy, Petten, THE NETHERLANDS**

Presenter's biography:  
tbd

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Session reference: 2CV.2.23

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Techno-Economic Performance Analysis and Life Cycle Assessment of Biomass Gasification Power Plant with/without a Tar-Controlled System**

Short introductive summary:

To help resolve the issues of tar formation and the subsequent disruption of gasification performance, a real time control system is being developed with the aim to minimise tar formation and by adjusting operating parameters accordingly. Techno-economic performance analysis and life cycle assessment of biomass gasification power plant with/without a tar-controlled system were carried out to quantify the financial and environmental benefit of a real time controlled gasification system for the reduction of tar.

Presenter: **Zhongyuan LI, University of Manchester, School of Mechanical, Aerospace & Civil Engineering, Manchester, UNITED KINGDOM**

Presenter's biography:

Research Associate in Tyndall Manchester, School of Mechanical, Aerospace & Civil Engineering, University of Manchester.

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Session reference: 2CV.2.24

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Potential Yield of Dedicated Energy Crops Across the Usa: Results and Outcomes of the Multi-Year Sun Grant Regional Feedstock Partnership

Short introductive summary:

The Sun Grant Regional Feedstock Partnership commenced in 2007 with the goal of supporting the realization of the biomass potential envisioned in DOE's 2005 Billion Ton Report. Concluding in 2016, the partnership sought to increase the knowledge of bioenergy through coordinated feedstock research across the lower 48 states and Hawaii with partners in academia, government, and private industry. Production and management data, as well as biomass composition characteristics, provide empirical support of logistic design and feedstock supply systems. These data and maps are vital for policy makers, producers, end-users, and others in the bioeconomy.

Presenter: **Vance OWENS, South Dakota State University, North Central Sun Grant Center, Brookings, USA**

Presenter's biography:

Vance Owens received BS, MS, and PhD degrees at Brigham Young University, Utah State University, and the University of Wisconsin-Madison, respectively. He is Director of the North Central Regional Sun Grant Center and Professor of Plant Science at South Dakota State University.

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Session reference: CP.1.1

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## The Role of Bioenergy in Future Energy System

Short introductive summary:

The ongoing energy transition is mainly driven by reductions in the cost of wind and solar energy, and political efforts to reduce greenhouse gas emissions. Although substantial deployment of variable renewable energy (VRE) is an important part of the overall transformation, rapid changes in the energy mix may pose challenges to the resilience of the electricity grid, particularly in times of weather-related stress. As fossil generation capacity is being retired and replaced by VRE generation, it raises the important question of how to maintain the stability and reliability of future energy supply. Although climate and energy policies of the past have been largely focused on electricity, most of the energy keeps being used for heating, cooling, and transport. These sectors have remained deeply reliant on fossil fuels and significant decarbonisation efforts are needed to ensure that the overall emission pledges of the Paris Accord can be met. In addition to sector-specific measures, it is essential to recognize the links between electricity, heat and transport and exploit synergies so that these sectors will support each in the effort to decarbonize. Bioenergy has some unique properties that can address many of the problems related to the rapid transition to a low-carbon energy system. When sustainably sourced and used, bioenergy can (i) provide low-carbon energy to complement wind and solar (residual load and grid stabilization) in the electricity sector, (ii) store electricity chemically into fuels to enable more efficient use of wind and solar, (iii) provide sustainable fuels for sectors where other decarbonisation options are not available or exceedingly expensive, (iv) coproduce heat, fuels and electricity in a single high-efficiency processing plant.

Presenter: **Antti ARASTO, VTT Technical Research Centre of Finland, Espoo, FINLAND**

Presenter's biography:

Antti Arasto, D.Sc. (Tech), Research Manager of Sustainable energy and chemical technologies area. Antti is a leader, with wide perspective to energy and research. He is expert in techno-economic assessment especially related to bioenergy, biofuels use and conversion, biorefinery and CCS.

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Session reference: CP.1.2

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

## **Zambezi Biorefinery: a Unique Process to Produce Pure Glucose, a Mixed Sugar Syrup and Lignin**

Short introductive summary:

In this presentation particular attention will be given to the Zambezi technology for the production “pure” 2nd generation glucose, a mixed sugars stream and a pure lignin stream that are produced during this process. The Zambezi process is based on the concentrated HCl Bergius process. Avantium has achieved a range of technological improvements on the concentrated mineral acid based process to make the process techno-economic competitive. A consortium consisting of AkzoNobel, RWE, Chemport Europe, Staatsbosbeheer and Avantium has been established to bring this technology to commercial scale. As a first step a demonstration plant is being built in Delfzijl, the Netherlands to be operational mid-2018. The subsequent Flagship plant processing around 135.000 ton bone dry biomass/annum will be operational at the beginning of next decade.

Presenter: **Ed DE JONG, Avantium Chemicals BV, Vice President Development, Amsterdam, THE NETHERLANDS**

Presenter's biography:

Ed is VP development at Avantium responsible for all public-private partnerships. Co-Chair of IEA Bioenergy Task 42 on Biorefineries

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Session reference: CP.1.3

Subtopic: 6.4 Biochemical Conversion

Topic: 6. INDUSTRY SESSIONS

## **Large Scale Bio Energy Lab II: Integrated Biogas and Hydrogen Production, Novel Products & Energy Storage from Renewably Generated Electricity**

Short introductive summary:

The combination and integration of the biomass sector and the electricity production from wind and solar is one of the challenges to ensure 100 % of renewable energy in all sectors, e.g. the transport and industrial sector.

Presenter: **Lars JÜRGENSEN, Aalborg University Esbjerg, Energy Technology Dpt., Esbjerg, DENMARK**

Presenter's biography:

Lars Jürgensen did his PhD at Aalborg University Esbjerg focusing on the catalytic methanation of biogas for the utilization of surplus electricity from wind and solar power. Now he is part time postdoctoral researcher at Aalborg University and part time project manager at GP JOULE, a company developing storage schemes for renewable energy in Northern Germany.

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Session reference: CP.1.4

Subtopic: 5.1 Strategies for bioenergy integration into energy systems

Topic: 5. BIOENERGY IN INTEGRATED ENERGY SYSTEMS

## Why Intermediate Pyrolysis with Integrated Reforming Makes the Difference!

Short introductive summary:

A sustainable and integrated approach for the use of residue and waste biomass can be a key contribution for the European energy transformation. The enormous potential of residues from biogas plants or sewage sludge for example can be utilized for power generation. Also lowering the use of fossil oil and carbon sequestration are important goals. To meet these requirements a staged intermediate pyrolysis with an integrated catalytic reforming step, the thermo-catalytic reforming TCR® was developed by Fraunhofer UMSICHT. Biomass is converted into a high quality oil, a hydrogen rich gas and volatile free char. The integrated reforming enables the upgrading of the products: The bio-oil has a low water and oxygen content. A big advantage is the thermal stability of the bio-oils, allowing distillation and hydrodeoxygenation. Hydrogen from TCR®-gases can be used for the upgrading of TCR®-oil or alternatively the gases can be burned in a dual fuel engine. Also the char including mainly ash and carbon has unique properties. Due to its stability it can be used for carbon sequestration or combusted to generate heat and power.

Presenter: **Samir BINDER, Fraunhofer-Institut UMSICHT, Sulzbach-Rosenberg, GERMANY**

Presenter's biography:

Samir Binder holds a degree in aeronautical engineering. Since 2009 he has worked as head of the department of Renewable Energy and head of operations at the Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT in Sulzbach Rosenberg/Germany.

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Session reference: CP.1.5

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## From Biomass Residues to Drop-In Diesel By Hydrofaction

Short introductive summary:

Steeper Energy is at the leading edge of global advancements in HTL commercialization; efficiently converting wood and biomass residues to on-specification diesel and other fuels for long distance transportation. After thousands of operating hours at a continuous pilot plant, Steeper has proven high oil yields (45% mass and 80% energy basis) of low-oxygen biocrude (10 wt%) using Hydrofaction™. This proprietary technology can process wet biomass and utilizes high-density, supercritical water chemistry at distinctly higher pressures and temperatures than competing HTL proponents. Steeper has developed technologies for upgrading Hydrofaction™ Oil to on-specification diesel and marine fuels. The high conversion efficiency of Hydrofaction™ translates to enhanced GHG emission reductions when replacing fossil diesel, jet and marine fuels. The paper will present the cost- and energy effective production of diesel and marine fuels by Hydrofaction™ as well as the status of an Industrial Scale Demonstration and De-risking plant currently under development for commercial deployment of Hydrofaction™ and availability of cost-effective long transport fuels.

Presenter: **Steen Brummerstedt IVERSEN, Steeper Energy Aps, Hoersholm, DENMARK**

Presenter's biography:

Dr. Iversen is a cofounder & CTO of Steeper Energy. He has more than 25 years experience within the energy, renewables, environmental industries. He has taken 7 new technologies from idea to commercial demonstration. He holds more than 200 patents across 45 patent families (24 within HTL).

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Session reference: CP.1.6

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



**Next Generation Fuel Flexible Residential Biomass Heating Based on an Extreme Air Staging Technology with Ultra-Low Emissions**

Short introductive summary:

The fuels utilised in present residential biomass heating boilers are almost exclusively wood fuels (log wood, pellets and wood chips). In case of pellet boilers, they are usually additionally restricted to pellets satisfying high quality demands (i.e. EN ISO 17225-2-A1) and state-of-the-art residential-scale wood chip boilers can only utilise fuels within a limited moisture content range (up to 35 wt% w.b.) as well as with moderate ash contents. As it is a dedicated aim of the EC and the member states to promote the utilisation of biomass fuels for energy production as a measure for CO<sub>2</sub> emission mitigation and since the high quality wood fuel resources are not available in high volumes in many European regions, the fuel spectrum to be applied in residential biomass combustion systems must be broadened in order to cover the rising fuel demand while avoiding increasing fuel prices in future. In addition, emission reduction with a key focus on dust is of great relevance. Moreover, measures to further increase the thermal efficiency of residential biomass boilers are required to keep them competitive in comparison with fossil fuel based systems also in terms of energy labels.

Presenter: **Ingwald OBERNBERGER, Bios Bioenergiesysteme, Graz, AUSTRIA**

Presenter's biography:

Prof. Univ.-Doz. DI Dr. Ingwald Obernberger  
Managing Director of BIOS BIOENERGIESYSTEME GmbH  
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Session reference: CP.1.7

Subtopic: 2.2 Biomass and bioliquids combustion for small and medium scale applications

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Pennycress (*Thlaspi Arvense*) a New Non-Food Crops for Oil-Based Biofuel Production in Europe and Usa**

Short introductive summary:

A comprehensive evaluation of a new non-food oilcrop, pennycress, is presented. The agronomic performance of the crop was tested in four different environments (2 in Europe and 2 in the USA). Extracted oil from seed samples of each test location was characterized for its chemical composition as well as its potentiality to be converted into biodiesel.

Presenter: **Federica ZANETTI, Università degli Studi di BolognaPadova, DIPSA, BOLOGNA, ITALY**

Presenter's biography:

Assistant Professor at the University of Bologna (Italy). Researches cover different aspects of agronomy and crop physiology evaluating the introduction of promising new oilcrops into typical farming systems

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Session reference: 1CO.5.1

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

**Cold-Tolerant Forage Sorghum as a Potential Bioenergy Feedstock in North Central US**

Short introductive summary:

Forage sorghum (*Sorghum bicolor*) is a warm-season annual grass used mainly as a silage or hay crop in the USA with the potential to become a bioenergy feedstock. Cold-tolerant forage sorghum genotypes would allow an earlier planting and optimum use of the growing season. This will likely lead to an increase in productivity of forage sorghum in the North Central Region. The objective of this study was to screen and select potential cold-tolerant forage sorghum genotypes with the hypothesis that cold tolerant genotypes were able to produce greater or similar dry matter yield when seeded early in the field (10 May). The experiments were conducted in Fargo and Hickson, ND. First, 74 commercial cultivars of forage sorghum and 10 cold-tolerant genotypes of grain sorghum were tested at 24°C and 12°C in controlled temperature and light growth chambers. In the field, cv. SPX-901 was among the highest yielding genotypes (16.4 Mg ha<sup>-1</sup>), its yield was similar between both dates indicating planting it earlier did not affect crop performance and yield. Preliminary conclusions indicate cold tolerance exists among commercial cultivars which can have greater biomass yield planted earlier

Presenter: **Marisol BERTI, North Dakota State University, Plant Sciences Dpt., Fargo, USA**

Presenter's biography:

Dr. Marisol Berti is a professor in the Department of Plant Sciences, North Dakota State University (NDSU), Fargo, ND, USA. She has been working in NDSU since 2009. She is an agronomist by training and her research is in forages, biomass, and cover crops production. She is the principal investigator of recently awarded multistate and multidisciplinary project on cropping systems. She is president of the Association for the Advancement of Industrial Crops (AAIC) and editor-in-chief of the journal Industrial Crops and Products. She presents at numerous regional, national, and international meetings. She has over 50 peer-reviewed publications and 100 presentations in conferences and symposia around the world.

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Session reference: 1CO.5.2

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

**Sowing Dates Effect on Camelina Growth in Different Eu Climatic Zones**

Short introductive summary:

*Camelina sativa* (L.) Crantz, is an annual plant belonging to the Brassicaceae family, as rapeseed, which only recently it gained the interest of the energy and bio-based industries as a low-cost non-food crop. The crop is being studied during the last three years (2015-2017) by the on-going EU-funded project 'COSMOS - Camelina & crambe Oil crops as Sources for Medium-chain Oils for Specialty oleochemicals', along with crambe, for the production of several biobased products. Field trials are performed at different locations in Europe to assess the effect of cultivation practices on seed yields, seed oil content and seed oil profile. In this work, field trials were established by CRES (Greece), UNIBO (Italy) and UWM (Poland) to study the effect of sowing dates on camelina seed and oil yields, in three different environments, the South (Greece) and North Mediterranean (Italy) climatic zones as well as the Continental zone (Poland). Results were very encouraging, demonstrating the good adaptability of camelina to the tested climates. Camelina could grow either as a winter or spring crop in the Mediterranean environments, but in Northern countries, it is only a spring crop.

Presenter: **Myrsini CHRISTOU, Center for Renewable Energy Sources and Saving, Biomass Dpt., Pikermi, GREECE**

Presenter's biography:

Agriculture engineer, MSc, leader of CRES Biomass department. Over 25 years of experience as coordinator and scientific responsible in a range of European and national RTD projects on technical evaluation of several biomass feedstocks in integrated biomass value chains for energy and biorefinery concepts.

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Session reference: 1CO.5.3

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Miscanthus for Biogas Production: Optimal Harvest Date and Ensiling

Short introductive summary:

Four miscanthus genotypes were analysed for their dry matter yield, substrate-specific methane yield and green-cut tolerance at three different harvest dates (end of September, mid-October, end of October) over two years to find the optimal harvest date for miscanthus used as biogas crop. Additionally, it was tested whether miscanthus can be ensiled, as this is required to render the green-cut biomass storable. The results of this study contribute to the large-scale implementation of miscanthus cultivation as a biogas crop.

Presenter: **Anja MANGOLD, University of Hohenheim, Biobased Products and Energy Crops, Stuttgart, GERMANY**

Presenter's biography:

Bachelor and Master studies at the University of Hohenheim from 2011-2016 (degree in Biobased Products and Bioenergy). Since 2016 PhD student at the department of Biobased Products and Bioenergy at the University of Hohenheim.

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Session reference: 1CO.5.4

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## **The Environment, Energy and Economic Benefits of using Energy Crops as a Strategy for Remediating Contaminated Lands**

Short introductive summary:

Fast growing species such as willow are efficient at sequestering heavy metals and other contaminants from the ground. When the crops are harvested the contamination is effectively transformed from a dispersed contamination on land to a much more concentrated form within the crop. Energy can then be extracted from the crop through a bioenergy pathway and the residues from the conversion process can be effectively managed to capture the original dispersed contamination. Energy crops may therefore provide a valuable environmental service and mechanism for remediating contaminated lands in addition to providing a feedstock for bioenergy.

Our project analyses both new and existing energy crop plantations, to evaluate their potential to both remediate contaminated lands in addition to providing feedstock for bioenergy. This abstract proposes to present the preliminary results from two core themes of the research: focusing on analysing the spread of contaminated lands across the UK and extent that biomass resource may be grown on these lands; and the economic benefits that may be achieved through remediating contaminated lands through an energy crop remediation strategy.

Presenter: **Andrew WELFLE, University of Manchester, Manchester, UNITED KINGDOM**

Presenter's biography:

Andrew Welfle is a Research Associate with the Tyndall Centre for Climate Change Research at the University of Manchester UK. Andrew's research interests are biomass resource modelling, bioenergy scenarios, the global trade of biomass trade for energy end uses, the GHG performance of bioenergy and the wider benefits and impacts of bioenergy pathways. Andrew also has experience of lifecycle assessment and analysis of bioenergy policy. Prior to joining the Tyndall Centre, Andrew worked for an engineering consultancy specialising in sustainability and energy of the built environment.

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Session reference: 1CO.5.5

Subtopic: 1.6 Integrated biomass production for energy purposes

Topic: 1. BIOMASS RESOURCES

## The Challenge of Biomass Quantification for the Emerging Bio-Based Industry

Short introductive summary:

The current study presents a description of the current market of different categories of the emerging bio-based products (like platform chemicals, polymers, lubricants and surfactants, among others) including an estimation of the use of biomass by the sector. This study also illustrates the distribution in the EU of different type of biorefineries, i.e. facilities producing innovative bio-based products and/or energy, and the analysis of the relationship between geographical location and availability of biomass of first (food/feed biomass), second (lignocellulosic biomass and biowaste) and so-called third generation (algae). This analysis will help better understanding the link between biomass feedstock and emerging bio-based products.

Presenter: **Claudia PARISI, European Commission Joint Research Centre, D4 - Economics of Agriculture, Seville, SPAIN**

Presenter's biography:

Scientific fellow at the EC-JRC researching in the topic of Bioeconomy, with a focus on emerging bio-based products, and Biotechnology.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 4CO.6.1

Subtopic: 4.5 Resource efficient bioeconomy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **From Strategy to Practice: the Role of Bio-Refineries and Cascading in Regional Bioeconomy Clusters Compared to Strategies and Projections**

Short introductive summary:

This study investigated the role of bio-refineries and cascading for bio-based chemicals, materials and energy in a future European bio-based economy by combining an explorative bottom-up approach involving regional bioeconomy clusters with a meta-analysis of bioeconomy strategies and scientific projections.

The results provide an overview and comparison on the current efforts regarding bio-based chemicals and materials, bio-refineries and cascading on a regional level and at the same time highlight differences and potential mismatches between overarching bioeconomy strategies and the current developments in the clusters. The results furthermore identify and contrast promising pathways for bio-based chemicals and materials and discuss innovative developments, drivers and hurdles from the perspective of bioeconomy-clusters.

This study lays the basis for further research on the opportunities and challenges of bio-refineries and cascading and allows to adjust current bio-economy projections.

Presenter: **Paul STEGMANN, Utrecht University, Copernicus Institute for Sustainable Development, Utrecht, THE NETHERLANDS**

Presenter's biography:

Paul Stegmann is a PhD Candidate at Utrecht University in the Netherlands. In his research he focuses on the role of bio-based chemicals & materials and how cascading and recycling could improve the environmental performance of the bio-based economy.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 4CO.6.2

Subtopic: 4.5 Resource efficient bioeconomy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY



## How Well are the Early-Stage Environmental Assessment Methods in Developing Novel Bio-Based Chemicals?

Short introductive summary:

The chemical industry strives for the development of bio-based alternatives to replace fossil-based chemicals driven by the transition to a bio-based economy. Key in this transition is “safe and sustainable by design”, which means safety and sustainability are taken into account at the earliest possible development stages. Many sustainability assessment methods have been developed for this purpose. The aim of this paper is to implement 12 selected early stage methods using bio-based lactic acid as a retrospective case study, to understand the applicability, the relevance of the methods for bio-based chemicals and the coherence of the outcomes compared to those based on the assessment of commercialized production. The results indicate that these methods 1) are often not fully described in literature and the databases are outdated; 2) are often incomplete, missing important themes for bio-based products, such as land-use; and 3) differ amongst each other in how indicators are quantified, resulting in different conclusions. Successful elements of existing methods are combined as a proposal for a framework that supports sustainable development in every phase of R&D.

Presenter: **Li SHEN, Utrecht University, Copernicus Institute of Sustainable Development, Utrecht, THE NETHERLANDS**

Presenter's biography:

Dr. Li Shen is Assistant Professor at Utrecht University, Copernicus Institute of Sustainable Development. Her research interests include technology assessment bio-based materials, nano materials and industrial chemicals, particularly in the context of energy, material efficiency and climate change.

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Session reference: 4CO.6.3

Subtopic: 4.5 Resource efficient bioeconomy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **The Role of Renewable Jet Fuel in the Bio-Economy: the Techno-Economic Feasibility of Renewable Jet Fuel and its Potential to Reduce the Climate Impacts of Aviation**

Short introductive summary:

This work synthesizes recent research on the technical, environmental and economic feasibility of renewable jet fuel (RJF) produced from biomass. It presents a comprehensive vision on the factors affecting the potential of RJF to reduce the climate impact of aviation in the coming decades, based on a number of recently published<sup>1–5</sup> and forthcoming studies. We find that the use and production of RJF is technically feasible and can lead to climate mitigation, depending on the production context and methodological choices. Based on the anticipated European regulatory context, we estimate that 165-261 PJ (3.8-6.1 Mt) RJF will be produced in the EU in 2030. This implies that RJF will contribute to substantial emission reductions in the aviation sector (12-19 Mt CO<sub>2</sub>) and will comprise 30% of projected biofuel production in the EU in 2030, thus playing a significant role in the future bio-economy.

Presenter: **Martin JUNGINGER, Utrecht University, Copernicus Institute, Utrecht, THE NETHERLANDS**

Presenter's biography:

Prof. Dr. Martin Junginger is professor Bio-Based Economy at Utrecht University. He published >55 articles in peer-reviewed journals, was contributing author to the bioenergy chapter of the IPCC SRRES, is editor of 3 books, and leader of IEA Bioenergy Task 40.

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Session reference: 4CO.6.4

Subtopic: 4.6 Biomass strategies and policies

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Overview and current status of EU funded actions on Bio-fuelled Heating and Combined Heating & Power within the Energy Challenge of Horizon 2020**

Short introductory summary:

This document provides an overview and a summary of current status of the EU-funded projects in the area of Combined Heat and Power (CHP). It focuses on the Horizon 2020 programme for research and innovation (2014-2020), more specifically on the Low Carbon Energy (LCE) calls of the two first Work Programmes (2014-2015 and 2016-2017).

Presenter: **Daniel MARAVER DE LEMUS, European Commission - INEA, H2020 Energy Research, Brussels, BELGIUM**

Presenter's biography:

Former Researcher, Project Manager and Lecturer. Currently Project Officer on H2020 Energy Research in the Innovations and Networks Executive Agency (European Commission) in charge of the CHP and the Renewable Heating and Cooling portfolios

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Session reference: 4CO.6.5

Subtopic: 2.4 Gasification for power, CHP and polygeneration

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Explosive Decompression Pretreatment - Nitrogen or Flue Gas?

Short introductive summary:

We are glad to submit a research article entitled "Explosive decompression pretreatment – nitrogen or flue gas?". This paper presents a novel biomass pretreatment method that uses high pressured N<sub>2</sub> or synthetic flue gas mixture and temperature to break the hemicellulose and lignin seal around the cellulose macro fibrils in the cell walls of the lignocellulosic biomass in order to open up the biomass structure for more efficient enzymatic hydrolysis. We have shown that pretreatment effectively increased and altered the surface area of biomass therefore pretreated samples had higher glucose yield than the blank samples.

Presenter: **Merlin RAUD, Estonian University of Life Sciences, Institute of Technology, Tartu, ESTONIA**

Presenter's biography:

<https://www.etis.ee/Portal/Persons/Display/fc35f287-d832-4823-a5d2-3183626d0f81>

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Session reference: 3CO.7.1

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Extraction of Arabinoxylans from Brewer's Spent Grain through Alkaline Pretreatment at Atmospheric Pressure**

Short introductive summary:

In this work, extraction of arabinoxylans (AX) from brewer's spent grain (BSG) by alkaline pre-treatment at atmospheric pressure was evaluated. This study is necessary to determine operation conditions of AX extraction. NaOH concentration, temperature, feed ratio (weight of BSG to volume of alkaline solution) and stirring velocity effects on AX concentration were studied through and experimental design which considers severe and moderate process conditions at high and low level. Concentration of AX extracted in the liquid fraction, and content of protein, lignin and structural carbohydrates in the water insoluble solid (WIS) were measured. AX yield from 42.5% to 76.0% were obtained in the liquid fraction. The highest yield was obtained at the moderate high level process condition (40°C and 4 M NaOH) after 12 h of treatment. Alkaline extraction of AX from BSG were both effective at atmospheric pressure and low temperature.

Presenter: **Lilia ROJAS, National University of Colombia, Bogotá, COLOMBIA**

Presenter's biography:

I am graduated in Chemical Engineering (National University of Colombia, 2008), currently I am studying PhD in Chemical Engineering at the same university. My principal research interests are bioprocess engineering, enzymology and biorefinery, my focus of interest is the use lignocellulosic biomass.

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Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## On the Assessment of Pretreatment-Dependent Physicochemical Properties, and their Link with Enzymatic Digestibility: a Multi-Scale Approach

Short introductive summary:

By the inherent recalcitrant behaviour of lignocellulosic substrates towards cellulolytic enzymes, the development of such biochemical pathway is still slow. Hence finding the pertinent descriptors driving the enzymatic digestibility of pretreated lignocellulosic feedstock is crucial for a global expansion of this technology.

This study makes a link between physicochemical features of dilute-acid pretreated wheat straw samples and their enzyme digestibility. Various operating pretreatment conditions were performed, in order to assess physicochemical modifications from a wide range of pretreatment severity. The innovative trait relies on its multi-technique approach that was chosen in order to focus on complementary parameters that can explain changes in the substrate enzymatic digestibility. When relevant, analyses over the enzymatic hydrolysis were also performed (in an ex situ and in situ manner), to get closer to the degradation mechanisms.

Among the properties assessed, accessible surface area appeared to be the main descriptor for mild operating conditions, whereas for harsh pretreatments chemical inhibition has been shown to limit considerably the substrate digestibility

Presenter: **Joël PASSICOUSSET, IFPEN, Physics and Analyses, Lyon, FRANCE**

Presenter's biography:

- 3rd year PhD thesis in progress (2015-2018), on multi-technique and multi-scale characterisation of pretreated lignocellulosic biomass, with ex and in situ approaches
- Engineering school in materials science and surface treatments

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Session reference: 3CO.7.4

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Impact of the Explosive Decompression during Steam Explosion Pretreatment of Wheat Straw

Short introductive summary:

Bioethanol represents an important biomass-derived fuel, which can be produced by the biochemical conversion of lignocellulosic biomass. Currently, the steam explosion pretreatment is often defined as the best pretreatment at the economic and industrial level. That is why, this pretreatment are widely studied in the literature. However, only a few studies are specifically interested in the impact of explosive decompression on the reactivity of substrates to enzymatic hydrolysis.”

Presenter: **Charlotte LOUSTAU CAZALET, IFP Energies nouvelles - établissement de Lyon, Solaize, FRANCE**

Presenter's biography:

After my graduation, i worked for one year at the INRA labs of Montpellier for biofuel production by dry fractionation of lignocellulosic biomass. Since 2015, i am a PhD student at IFP New energies and her thesis is co-supervised by INP Pagora Grenoble and the laboratory of Gembloux Agro-Bio Tech

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Session reference: 3CO.7.5

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Compact Gasification and Synthesis process for Transport Fuels

Short introductive summary:

The aim of the work done under H2020 funded project "COMSYN" is to develop a new BTL production concept that will reduce biofuel production cost up to 35% compared to alternative routes. This means 0,80 €/l production cost for biodiesel, which is a significant reduction compared to earlier processes. The production concept is based on distributed primary conversion of various kinds of biomass residues to intermediate liquid products with small-to-medium scale (10-50 kt/a FT products) units located close to biomass resources. The primary conversion will be integrated to local heat and power production resulting in 80 % energy efficiency in biomass utilization. The FT products will be refined to high quality drop-in liquid transport fuels at existing oil refineries. The produced FT-wax will be transported to existing large scale oil refinery, which will be gradually converted into biofuel refinery as the number of primary conversion plants increases.

Presenter: **Johanna KIHLMAN, VTT, Espoo, FINLAND**

Presenter's biography:

Johanna Kihlman, M.Sc. (Tech), has background in biomass gasification gas cleaning, especially by catalytic steam reforming. She has been involved in several national and EU projects related to gas treatment in gasification and fuel cell processes.

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Session reference: ICO.8.1

Subtopic: 6.2 Thermochemical conversion processes

Topic: 6. INDUSTRY SESSIONS



## The Dall Energy Biomass Gasifier

Short introductory summary:

A full scale Dall Energy biomass gasifier plant is under construction in Sindal, Denmark.

Several unique features will be demonstrated:

- Fuel flexibility (Garden Waste and other, 20-60% water content)
- High turn down ration 1:10
- Dust out of gasifier below 10 mg/Nm<sup>3</sup>
- Tar content below 50 mg/Nm<sup>3</sup>

Presenter: **Jens Dall BENTZEN, Dall Energy, R&D, Hørsholm, DENMARK**

Presenter's biography:

Mr. Bentzen graduated in 1995 with a MSC in thermal gasification of biomass

In 2007 Dall Energy was founded.

Focus was put on the development and verification of the Dall Energy biomass furnace, which offers:

- Fuel flexibility
- High Turn down ratio : 10-100%
- Low emissions: Dust, NOx and CO.

*Biographies and Short introductory summaries are supplied directly by presenters and are published here unedited*

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Session reference: ICO.8.2

Subtopic: 6.2 Thermochemical conversion processes

Topic: 6. INDUSTRY SESSIONS

## Numerical Analysis of a Combined Heat and Power Generation Technology from Residual Biomasses

Short introductive summary:

A numerical model of a CHP layout composed by a biomass gasifier, syngas cleaning and ICE, studied from a thermodynamic point of view within the Thermoflex™ environment, coupled to a one-dimensional (1D) model of the ICE module developed within GT-Suite.

The two numerical approaches allow estimating the effects of some important parameters on the CHP unit on the electric and thermal output, as the biomass initial moisture content, the equivalence ratio at the gasifier or the time of spark advance. This will permit to consider solutions to improve performance or extend the operating range in the absence of faults.

Presenter: **Carmine CAPUTO, Istituto Motori - Consiglio Nazionale delle Ricerche, Napoli, ITALY**

Presenter's biography:

I graduated in Mechanical Engineering for Energy and Environment, with a thesis: "A modeling approach to a hybrid motorization for ultralight aircraft". I'm currently a first year PhD student at the University of Rome Tor Vergata and I carry out my research at the CNR Engine Institute in Naples.

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Session reference: ICO.8.3

Subtopic: 6.2 Thermochemical conversion processes

Topic: 6. INDUSTRY SESSIONS

## **Autarkic Conversion of Woody Biomass to Biochar via PYREG Technology**

Short introductive summary:

Pyrolysis is well known technic to convert biomass into chars, liquids and gases. Normally the gas fraction is used to produce electrical power and the liquids as chemical starting materials. In the PYREG Technology both materials are combusted directly and only thermal energy can be used. With a new ORC module electrical power will be produced, so that the machine is autarkic in operation.

Presenter: **Kevin FRIEDRICH, PYREG GmbH, Dörth, GERMANY**

Presenter's biography:

- Diploma in biological process engineer at the university of applied sciences Bingen
- Founded an engineering office (Engineering office Böhm) in 2010
- Master degree in Energy-, Building- and Environmentalmanagement
- Since 2014 Head of R&D in the PYREG Company

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Session reference: **ICO.8.4**

Subtopic: **6.2 Thermochemical conversion processes**

Topic: **6. INDUSTRY SESSIONS**

## **Evaluation of Utilising Ingelia Hydrochar Produced from Organic Residues for Blast Furnaces Injection - Comparison with Anthracite and Bituminous Coal**

Short introductive summary:

The study is focused on the characterisation, basic and process performances of three hydrochar samples obtained from Ingelia industrial Hydrothermal Carbonisation plant, processing Green Waste (GW), Organic Fraction of Municipal Solid Waste, (OF) and Orange Peel (OP). These three biocoal samples have been compared with two fossil coals: a typical bituminous coal, and anthracite, in order to evaluate the potential use of hydrochar as renewable fuel for the steel sector

Presenter: **Andrea SALIMBENI, INGELIA SL, Valencia, SPAIN**

Presenter's biography:

Mr. Andrea Salimbeni, male, is an Energetic Engineer, graduated at the University of Florence, specialized in the biomass sector

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Session reference: **ICO.8.5**

Subtopic: **6.2 Thermochemical conversion processes**

Topic: **6. INDUSTRY SESSIONS**

## Optimizing Catalytic Tar-Deoxygenation of Fast Pyrolysis Vapors

Short introductive summary:

Process optimization of a bench scale fast pyrolysis set-up has been performed in order to screen the performance and stability of modified MFI zeolites in the ex-situ upgrading of straw and wood derived pyrolysis vapors.

Presenter: **Andreas ESCHENBACHER, DTU, Chemical Engineering, Hellerup, DENMARK**

Presenter's biography:

February 2017 - now: PhD program in Catalysis at the Technical University of Denmark

Topic: Use of Zeolites for Tar-Deoxygenation

2016 M.Sc. in Chemical Engineering, Technical University of Munich (Germany)

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Session reference: 3CV.3.2

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Advanced Renewable Gasoline from Waste Biomass - Experimental Investigation of a Novel Transportation Fuel**

Short introductive summary:

This work is focused on the experimental investigation of the exhaust emissions and brake specific fuel consumption of a novel renewable gasoline, meeting the requirements of the standard EN 228. The gasoline was generated from waste biomass (municipal sewage sludge) via Thermo-Catalytic Reforming (TCR®); producing crude TCR® bio-oil for catalytic hydrotreatment and refining to gasoline (EN 228) and diesel (EN 590).

Presenter: **Andreas APFELBACHER, Fraunhofer-Institut UMSICHT, Renewable Energy Dpt., Sulzbach-Rosenberg, GERMANY**

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Session reference: 3CV.3.4

Subtopic: 3.4 Oil-based biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Carbonization of Residual Biomass from River Maintenance Using Waste Heat from Gasification Power Plants**

Short introductive summary:

Basic idea of this work is to investigate the creation of complex integrated systems able to process various kind of biomasses.

Feedstocks with quality high enough are converted into electrical energy and heat. This heat drives a further pyrolysis stage where the poor quality biomass is carbonized.

Presenter: **Marco PUGLIA, University of Modena and Reggio Emilia, Carpi, ITALY**

Presenter's biography:

I am a mechanical engineer and during my thesis I started to study biomass gasification.. After I finished my master degree I spent a year as a research assistant studying the utilization of vine prunings as fuel for small scale gasifiers. Now I am a PhD student in the field of gasification.

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Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Physical Activation of Sewage Sludge Char with CO<sub>2</sub> for H<sub>2</sub>S Removal from Biogas**

Short introductive summary:

Sewage sludge (SS) is the major waste produced in the wastewater treatment plants, so its management is becoming a real challenge in the last decades. Thermochemical treatments, such as pyrolysis, appear as an interesting method for valorising this residue. At the same time, a great amount of SS is anaerobically digested, so an integrated process combining anaerobic digestion (AD) and subsequent pyrolysis of the digested SS is gaining interest. The biogas produced during the AD could contain impurities, such as hydrogen sulphide (H<sub>2</sub>S), which hinder its use for energetic purpose. The solid produced in the pyrolysis of SS (char) could be activated for working as a good adsorbent. Following the idea of a biorefinery and a process with fewer residues, we propose the use of the char from digested SS to remove H<sub>2</sub>S from the biogas produced during the AD of that SS. A physical activation stage is needed to change the textural properties of the char in order to improve its adsorption capacity. The main objective of this work is to study the physical activation of SS char with carbon dioxide (CO<sub>2</sub>) to improve its performance in the removal of H<sub>2</sub>S from the biogas produced during the a

Presenter: **Nadia RUIZ-GOMEZ, University of Zaragoza, Zaragoza, SPAIN**

Presenter's biography:

Nadia Ruiz is a PhD student at the Universidad de Zaragoza, Spain, where she obtained her Chemical Engineering degree in 2013. She got a Master on Renewable Energies at the CIRCE (Research Centre for Energy Resources and Consumption), Spain. She started to work on pyrolysis during her final master project, and now, her research activity is focused on pyrolysis of waste materials.

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Session reference: 3CV.3.8

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Prediction of Biomass Pyrolysis Plant Products

Short introductive summary:

Authors design a simulation of pyrolysis process based on a pilot-plant located in Caltagirone (Italy).

The work has two aims:

1. Try to enhanced percentage of bio-oil production modifying operative parameter;
2. Give a preliminary parameters and results to improve the process in the plant.

Paper includes a synthesis of pyrolysis pilot-plant, showing type, steam and dimension of biomass and describing operative parameters as heating rate, residence time and maximum temperature reached during the process. Moreover, there is an overview of the entire production cycle and an explanation of simulation blocks and parameters.

Eventually, to check reliability of results, the percentages of three products are compared with the ones collected through literature researches.

Presenter: **Antonio AGRIFOGLIO, University of Catania, Electric, Electronics and Computer Engineering Department (DIEEI), Catania, ITALY**

Presenter's biography:

PhD Student in "Systems, Energy, Computer and Telecommunication Engineering" at Department of Electric, Electronic and Computer Engineering - University of Catania

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Session reference: 3CV.3.9

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**The Catalytic Fast Pyrolysis of Acid-Washed Saccharina Japonica Alga in Fluidized-Bed Reactor for Upgrading Bio-Oil**

Short introductive summary:

Macroalgae contains significant amount of inorganic compounds (K, Na, Mg, Ca), causing the problems during thermal processing (ash fouling or agglomeration of char and bed material). *Saccharina japonica*, a kind of macroalgae, was demineralized with diluted acid solution to remove inorganic species before using this material for pyrolysis in a bubbling fluidized-bed reactor. The effect of acid washing on the product yield and the quality of bio-oil were investigated. When the pyrolysis temperature increased from 400 to 500 °C, the bio-oil yield was between 39.70 and 45.87 wt%. The major compounds in bio-oil were levoglucosan and di-anhydromannitol. The fractional catalytic pyrolysis of pre-treated *S. japonica* using HZSM-5 catalysts (calcined at 550 °C) was investigated at same conditions. The catalytic pyrolysis of the pre-treated sample resulted in 32.82–34.39 wt% liquid yield. The HHVs of catalytic pyrolysis bio-oil was in the range of 24.98–27.19 MJ/kg. Using HZSM-5 catalyst resulted in a reduction of dianhydromannitol, 2-furyl methyl ketone and in a formation of aromatic compounds. The catalytic pyrolysis produced higher CO and hydrocarbon gases than those of the conv

Presenter: **HOANG VU LY, Kangwon National University, Chemical Engineering, Samcheok, REPUBLIC OF KOREA**

Presenter's biography:

2010.03 - 2016.02 : Ph.D. student, Kyung Hee University

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Session reference: 3CV.3.10

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Fractional Catalytic Fast Pyrolysis of Bamboo in a Bubbling Fluidized-Bed Reactor

Short introductive summary:

In this study, the thermal conversion characteristics of bamboo was analyzed from 25 to 700 °C in nitrogen using thermogravimetric analysis, and it was mainly decomposed between 230 °C and 400 °C. The fast pyrolysis of bamboo was performed in a bubbling fluidized-bed reactor under various reaction conditions to investigate the effects of these parameters on product yield and bio-oil quality. The system used silica sand and dolomite catalyst as the fluidizing bed material and nitrogen as carrier gas. When the pyrolysis temperature increased from 400 °C to 550 °C, the bio-oil yield was between 38.07 and 47.11 wt.% compare to those of 33.38 and 42.63 wt% using dolomite catalyst. Dolomite rejected oxygen molecules in bio-oil, and C=O groups such as carboxylic acids and derivatives were decreased on the analysis of <sup>13</sup>C NMR spectra of bio-oil produced from bamboos at 450 °C with dolomite.

Presenter: **HOANG VU LY, Kangwon National University, Chemical Engineering, Samcheok, REPUBLIC OF KOREA**

Presenter's biography:

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Session reference: 3CV.3.11

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Stabilization of Pyrolysis Oils by Solvent Additions

Short introductive summary:

Pyrolysis oils show a time-dependent change of properties that can be deduced from a modification of their compositions (aging). This phenomenon contributes to unclear specifications of pyrolysis oils and impedes further processing steps.

One possible approach is the addition of solvents. In this context usually liquid solvents, especially alcohols, are employed to lower the viscosity, emulsify and reduce the acidity. Underlying mechanisms of aging and its influence by solvents are still discussed. On this subject, the results of two accelerated aging tests, modified approaches of the concept of Elliott et al., will be presented, including analytical-chemical results regarding mechanistic details.

Rarely applied is the addition of gaseous solvents even though the pyrolysis of biomass generates sufficient unused gaseous products. Therefore, a concept for measuring gas solubilities in pyrolysis oils is introduced, including experimental carbon dioxide solubilities. The utilization of carbon dioxide as a solvent for stabilizing pyrolysis oils is not only economically beneficial but also advantageous improving pyrolysis products to slurries and hydrogenated pyrolysis oils.

Presenter: **Clarissa BAEHR, Karlsruhe Institute of Technology, Institute of Catalysis Research and Technology, Eggenstein-Leopoldshafen, GERMANY**

Presenter's biography:

Since 2016 Clarissa Baehr (Master degree in Chemistry) is working on her PhD thesis at the Karlsruhe Institute of Technology.

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Session reference: 3CV.3.12

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Pyrolysis of Giant Reed (*Arundo Donax* L.) for Biochar Production

Short introductive summary:

A sound knowledge of biochar properties is critical because its physical and chemical characteristics are greatly affected by the starting feedstock and the processing conditions. Biochars are produced mainly from crop and forestry residues, but the exploitation of other sources could be result worthwhile. The giant reed (*Arundo donax*, L.) is one of the most important energy crop used in different thermochemical and biochemical conversions, but not yet thoroughly tested in the pyrolysis process. The study intended to offer a contribute for increasing the knowledge about the suitability of the *Arundo* in producing a high-grade biochar.

Presenter: **Francesco GALLUCCI, CREA-IT, Monterotondo, ITALY**

Presenter's biography:

Researcher at the Council for agricultural research and economics - Research Centre for Engineering and Agro-Food Processing (CREA-IT). He works on the energy conversion of biomass (combustion, gasification and anaerobic digestion). Authors of more than 40 scientific publications.

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Session reference: 3CV.3.13

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Mechanistic Study of Guaiacol Fast Pyrolysis using DFT Calculations, Microkinetic Model and Experiments**

Short introductive summary:

Lignin (15-30%) is the second abundant component in biomass and also a main by-product of the pulp and paper industries. The structure of lignin is complex and it is formed by polymerization of three phenyl propane monomers; viz. p-coumaryl, coniferyl, and syringyl alcohols. Moreover, the structure of lignin is also complicated by the presence of different linkages such as  $\beta$ -O-4,  $\alpha$ -O-4, 4-O-5, 5-5,  $\beta$ - $\beta$ ,  $\beta$ -1, and  $\beta$ -5. Among these, the most abundant linkages of lignin is  $\beta$ -O-4 (40- 60%). Fast pyrolysis is a promising thermochemical conversion technique for the production of valuable phenolics and aromatic hydrocarbons from lignin. For this reason, the molecular mechanism of transformation of lignin is vital for understanding and improving the fast pyrolysis and catalytic fast pyrolysis processes. Lignin pyrolysis mechanism can be reasonably well understood through the lignin model compounds like phenolic monomers and dimers. In this study, theoretical, kinetic and experimental analysis of fast pyrolysis of guaiacol, which is a model monomeric compound of lignin was investigated.

Presenter: **Yerrayya ATTADA, IIT MADRAS, CHEMICAL ENGINEERING, CHENNAI, INDIA**

Presenter's biography:

I AM A. YERRAYYA, I AM PURSUING Ph.D. IN IIT MADRAS, CHEMICAL ENGINEERING DEPARTMENT. I AM WORKING ON BIOFUELS AND CHEMICALS PRODUCTION FROM BIOMASS USING DIFFERENT THERMOCHEMICAL CONVERSION TECHNOLOGIES SUCH AS FAST PYROLYSIS, HYDROTHERMAL LIQUEFACTION AND MICROWAVE ASSISTED PYROLYSIS.

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Session reference: 3CV.3.15

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Influence of the Support on Ni Based Catalysts for Hydrogen Production in the Biomass Pyrolysis-Catalytic Steam Reforming**

Short introductive summary:

The aim of this research was to study the influence of the support on the performance of Ni catalysts used in the catalytic reforming of biomass fast pyrolysis volatiles.

The experiments have been conducted in a bench scale plant provided with a conical spouted bed reactor (CSBR) where the pyrolysis takes place at 500°C, and a subsequent fluidised bed reactor, in which the catalytic steam reforming of volatiles is performed at 600°C.

The results obtained at zero time on stream showed an almost complete conversion (98%) for the Ni/Al<sub>2</sub>O<sub>3</sub>, and a conversion of 91% when Ni/TiO<sub>2</sub> catalyst were tested. The activity of both catalysts decayed with time on stream due to the coke formed on the catalyst, however, this deactivation is less pronounced with Ni/Al<sub>2</sub>O<sub>3</sub>. The poor performance of Ni/TiO<sub>2</sub> is probably associated with the capacity of the support to provide an appropriate good dispersion, which is related with the lower surface area of the TiO<sub>2</sub> support compared with Al<sub>2</sub>O<sub>3</sub>.

It can be concluded that TiO<sub>2</sub> was not an adequate support while Ni/Al<sub>2</sub>O<sub>3</sub> showed the best activity and higher stability over time.

**Presenter:** Aitor ARREGI, University of the Basque Country, Chemical Engineering Dpt., Bilbao, SPAIN

Presenter's biography:

Chemical Engineer. PhD Researcher in the Chemical Engineering Department of the University of the Basque Country. Research fields: pyrolysis and catalytic steam reforming of biomass and plastic waste.

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Session reference: 3CV.3.16

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Investigation of the Pyrolysis Characteristics of Macroalgae Species *Ulva Lactuca*, *Miscanthus* and Wood Chips Mixtures**

Short introductive summary:

This work is focused on the determination of the thermochemical devolatilization characteristics of *Ulva lactuca*, a green algae species and mixtures of it with *Miscanthus* and wood chips. The aim of this study is to compare *Ulva lactuca* and its mixtures with the other biomass species regarding their thermochemical conversion potential. Additionally, the potential of those mixtures in terms of bio – energy and chemicals production will be explored and suggestions concerning their processing application will be formulated. This investigation will be based on pyrolysis experiments conducted using a Pyroprobe 5200 reactor.

Presenter: **Christos TSEKOS, TU Delft, Rotterdam, THE NETHERLANDS**

Presenter's biography:

- Diploma of Mechanical Engineering in National Technical University of Athens (2007 - 2013)
- Master of Science in Sustainable Energy Technology, Delft University of Technology (2014 - 2017)
- PhD Candidate in Delft University of Technology, Process and Energy Laboratory (2017 - present)

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Session reference: 3CV.3.17

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Effect of Biomass Pretreatment on Slow Pyrolysis Characteristics

Short introductive summary:

This submitted abstract is a study that examines the effect of biomass pretreatment on slow pyrolysis characteristics. It summarizes valuable results for comparing the performance of different biomass material to enhance the production of high quality chars, while producing high heating value gas mixture. This study's results can be a useful both for the scientific and the industrial community, since the yields acquired can be used for efficient design of this process while on the same time check the feasibility of investments on this field. The pyrolysis experiments has been performed on the facilities of the Royal Institute of Technology.

Presenter: **Panagiotis EVANGELOPOULOS, Royal Institute of Technology (KTH), Materials Science and Engineering, Stockholm, SWEDEN**

Presenter's biography:

I am a PhD student at the Royal Institute of Technology (KTH) and my major focus is thermochemical conversion technologies. Through the last 4 years I have been involved in several research projects and I have been working with pyrolysis of biomass and biomass residues for bio oil production.

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Session reference: 3CV.3.20

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Analysis of Produced Tars from Frictional Pyrolysis under Different Settings - The Influence of Reflux Condensation**

Short introductive summary:

Recently, the authors introduced a novel technology, which is defined as frictional pyrolysis and produces solid carbonaceous products from biomass. Contrary to conventional pyrolysis, this process propagates only by means of pressure- and friction – application. To assess the optimal operating conditions, the reactor has been operated with and without the reflux condenser. The two different operation modes result in solid carbonaceous products that have vastly different characteristics. Among the wide set of differences, the types of tar compounds that are produced from the two different configurations and captured in the pores of the materials were expected to have significant differences. Thus, the tar compounds were extracted from the solid products and analyzed in accordance with relevant standards [3]. The results will assist - on the one hand - the identification of utilization scenarios of the products. On the other hand, the data will be part of future work efforts that will focus on the reforming mechanisms of chars that react with tar-rich gases.

Presenter: **Marco BARATIERI, Free University of Bolzano, Faculty of Science and Technology, Bolzano, ITALY**

Presenter's biography:

Associate Professor in Thermal Engineering and Industrial Energy Systems at the Free University of Bolzano (Italy). M.Sc. and Ph.D. in Environmental Engineering, his main research field is thermochemistry of biomass gasification and pyrolysis.

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Session reference: 3CV.3.21

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Pelletization and Pyrolysis of Metallurgical Biochar

Short introductive summary:

This work addresses the substitution of fossil coal and coke with biochar in the Norwegian smelting industry. In particular, it aims at producing a competitive biochar by coupling pyrolysis and pelletization and using pyrolysis oil as binder into the pelletization.

Presenter: **Lorenzo RIVA, University of Agder, Grimstad, NORWAY**

Presenter's biography:

I am currently taking a PhD in Bioenergy at University of Agder, in Norway.

My research aims at improving the production and quality of biochar by pyrolysis.

Previously I have taken bachelor and master in Energy Engineering at Polytechnic of Milan, with focus on Energy for Development.

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Session reference: 3CV.3.25

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Industrial Scale Fast Pyrolysis of Brown Seaweed: Process Design, Simulation and Analysis of Three Cases

Short introductive summary:

In this study three process design cases of industrial scale pyrolysis of brown seaweed are simulated and compared in terms of economy, ecology, and energy expenditure. All simulations are based on in-house experimental data for fixed bed and fluidized bed pyrolysis of *Saccharina japonica* seaweed.

Presenter: **Jay LIU, Pukyong National University, Department of Chemical Engineering, Busan, REPUBLIC OF KOREA**

Presenter's biography:

Prof. Jay Liu, leader of Intelligent Systems Laboratory (ISL) at Pukyong National University, Korea is actively involved in research on Process Systems Engineering with focus on sustainability and bioanalytic issues. He received his PhD degree from McMaster University, Canada in 2004.

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Session reference: 3CV.3.27

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Oxidative Pyrolysis of Various Biomass in Fixed Bed: Yields, Composition and Properties of the Products**

Short introductive summary:

Oxidative pyrolysis is an effective way for the autothermal operation of staged gasification and carbonization processes. The aim of this work was to investigate the influence of biomass properties on yields, composition and properties of oxidative pyrolysis products: char, bio-oils and permanent gases. Oxidative pyrolysis of three biomass cases: -Pine, Miscanthus and Wheat straw- were performed in a 20 cm diameter fixed bed reactor. Quantitative and qualitative analyses of biomass and products were conducted. Temperatures along the bed were measured to be lower than 800°C in all cases of studied biomass. The mass and energy distribution in products were different between the studied cases. For example, char yields were 19%, 25% and 27% for Pine, Miscanthus and Wheat straw pellets, respectively. Oxidative pyrolysis has shown high energy efficiencies, higher than 80%, when converting biomass into char, bio-oils, and permanent gas. The results highlight the important role of biomass properties, such as ash content and density, on the oxidative pyrolysis features.

Presenter: **Xuan-Huynh PHAM, CIRAD, UPR114 BioWooEB, Montpellier, FRANCE**

Presenter's biography:

Third year PhD student studying at the CIRAD-BioWooEB-France with a subject of oxidative pyrolysis. I had a french master diploma in domain of waste treatment for energy and environment protection purposes. I participated to design and implement 2 hydropower plants (25MW) and some biogas projects.

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Session reference: 3CV.3.29

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Mild and Deep Hydrodeoxygenation of Pyrolysis Oil over Nickel Catalysts

Short introductive summary:

The present work will discuss the application of a nickel-based catalyst at two different conditions of severity, discussing the results obtained and the possible final application (blend with hydrocarbons, production of renewable fuels or even platform chemical production).

Presenter: **Caroline CARRIEL SCHMITT, Karlsruhe Institute of Technology, IKFT Dpt.,  
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Presenter's biography:

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Session reference: 3CV.3.30

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

## **Pyrolysis of Cassava Peels in Top-Lit Up-Draft Pyrolysis (TLUD-Pyro) Reactor**

Short introductive summary:

Cassava (*Manihot esculenta*) also known as yuca or manioc, is the fourth most grown crop around 273 million tons and the third largest source of carbohydrates for humans in the world. Cassava processing generates a huge amount of cassava peels, which cause serious environmental problems. However, by using TLUD-Pyro reactor cassava peels can be converted into valuable products like biochar, bio-oil, and pyrolysis gas.

Presenter: **Sajid LATIF, University of Hohenheim, Agricultural Engineering in the Tropics and Subtropics Dpt., Stuttgart, GERMANY**

Presenter's biography:

Sajid Latif did his Ph.D. in 2009 from University of Agriculture, Faisalabad by availing two scholarships from HEC, Pakistan. Right after his Ph.D. he was awarded with Humboldt postdoctoral fellowship at University of Hohenheim, Stuttgart, Germany. Now he is co-ordinating different projects.

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Session reference: 3CV.3.33

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

## Assessment of Syngas Produced from Gasification of Olive Tree Pruning in a Downdraft Reactor

Short introductive summary:

Gasification of agricultural residues is one of the most interesting solution for recovery of lignocellulosic biomass in order to produce energy and to solve environmental criticalities due to the management of biomass. This research concerns the gasification with air of olive tree pruning through a downdraft reactor for production of syngas and biochar. The aim was to assess the relationship between the syngas composition and parameters of gasification process. The syngas showed suitable characteristics, in terms of lower heating value, for power production through internal combustion engines while the biochar showed good properties as soil improver and as a tool for soil carbon sequestration.

Presenter: **Francesco GALLUCCI, CREA-IT, Monterotondo, ITALY**

Presenter's biography:

Researcher at the Council for agricultural research and economics - Research Centre for Engineering and Agro-Food Processing (CREA-IT). He works on the energy conversion of biomass (combustion, gasification and anaerobic digestion). Authors of more than 40 scientific publications.

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Session reference: 2CV.4.1

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



## Experimental Investigations of Combined Biomass and CO<sub>2</sub> Gasification in a Downdraft Gasifier

Short introductive summary:

Gas-fired and coal based power generation plants result in the emission of CO<sub>2</sub>, a major greenhouse gas responsible for climate change. On an average, the flue from such power plants contain approximately 12 – 17 vol.% CO<sub>2</sub>, 75 – 77 vol.% N<sub>2</sub> and ~4.4 vol.% O<sub>2</sub> with fractions of CO, NO<sub>x</sub>, CO<sub>2</sub> and SO<sub>2</sub> in ppm range. While the capture and storage of this CO<sub>2</sub> stream have been addressed actively in the literature, or even implemented rather unsustainably, its application in the fuel making process is imperceptibly addressed. This work examines the thermochemical biomass conversion with air and CO<sub>2</sub> as gasification media to explore the possibilities and limitations of CO<sub>2</sub> capture and its application in the fuel making process by the employment of the Boudouard reaction in the high temperature char zone to yield carbon monoxide.

Presenter: **Francesco PATUZZI, Free University of Bolzano, Faculty of Science and Technology, Bolzano, ITALY**

Presenter's biography:

Francesco Patuzzi received his PhD in 2014 and is presently assistant professor at the Faculty of Science and Technology at the Free University of Bozen-Bolzano (Italy). His research activities are mainly related to the study of thermochemical conversion of ligno-cellulosic biomasses.

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Session reference: 2CV.4.2

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Gasification of Cellulose and Lignin with Water Vapor

Short introductive summary:

The biomass can be used in energy applications for the production of heat, power and transportation fuels. The rational use of this product compounds can be the integral valorization of lignocellulosic biomass (Collard and Blin, 2014). The biomasses are composed of cellulose, hemicellulose and lignin in different proportions. Cellulose is the major components accounting for 40% of all carbon stocks in the plant (Rabelo, 2007), and Lignin is third major accounting components for 15-35% of the dry mass, and up to 40% of the energy content of lignocellulosic biomass (Ojha, Viju and Vinu, 2017). That's why is important to understand that the proportion of cellulose, hemicellulose and lignin. Are directly related to the biomass gasification behavior and to final gas products.

Presenter: **Humberto Horge JOSÉ, Federal University of Santa Catarina, Dep. of Chemical Engineering and Food Engineering, Florianópolis, BRAZIL**

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Session reference: 2CV.4.6

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Characterization of Char From Wood Gasification

Short introductive summary:

Useful applications for gasification char are being sought, as residual chars are currently considered waste materials, and they represent a cost in the economic balance of gasification plants. The repurposing of char would be especially beneficial for small-scale gasifiers. This study aimed at characterizing gasification char and showing a possible utilization way for residual chars for example in producer gas cleaning.

Presenter: **Zsuzsa SÁROSSY, Technical University of Denmark, Chemical and Biochemical Engineering, ROSKILDE, DENMARK**

Presenter's biography:

Zsuzsa Sárossy is a researcher at the Department of Chemical and Biochemical Engineering, Technical University of Denmark (DTU). She has received her PhD in Chemical Engineering at DTU in 2012. Her research focuses on tar characterization from biomass gasification.

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Session reference: 2CV.4.8

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **A Novel Cost Management Strategy for SELEXOL Syngas Purification Process Using Optimal Integration of Ejector Technology**

Short introductive summary:

Gasification is one of the most promising thermochemical pathways to exploit biomass as a renewable source to produce energy and value-added products. Syngas purification is a key step for successful implementation of syngas conversion processes, as it often suffers from high capital and operating costs. In this work, we introduce a novel approach to reduce the capital and operating costs of the widely-used SELEXOL syngas purification process by optimal integration of ejector technology. A detailed simulation model of SELEXOL has been developed using Aspen HYSYS® in order to find an optimal strategy for integrating ejector technology into this process and also to assess benefits of the novel design configurations from economic, energy and environmental perspectives. Moreover, we developed a predictive thermodynamic design model to simulate ejector performance over a wide range of operating conditions and scales. We found that by optimal integration of ejector technology into the SELEXOL gas purification process, the capital and operating costs of the combined solvent regeneration and CO<sub>2</sub> compression system can be reduced by up to 30% and 10%, respectively.

Presenter: **Hamed BASHIRI, Natural Resources Canada, CanmetENERGY, Varennes, CANADA**

Presenter's biography:

Hamed is a research scientist at CanmetENERGY that is Canada's leading research and technology organization in the field of clean energy.

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Session reference: 2CV.4.9

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Influence of the Catalyst Support on the Steam Reforming Performance of Tar Model Compounds**

Short introductive summary:

Gasification is considered one of the most promising technologies for biomass exploitation. One of the main drawbacks is the high amount of tar produced along with the syngas. In this work the catalytic reforming of tar will be studied over different catalysts sharing the same active specie, Ni, supported on different materials. The influence of the support of the catalyst on the catalyst deactivation due to the coke formation will be investigated.

Presenter: **Benedetta DE CAPRARIIS, Sapienza University of Rome, Department of Chemical Engineering, Rome, ITALY**

Presenter's biography:

Benedetta de Caprariis is an assistant professor at the department of Chemical Engineering of Sapienza University of Rome. Her research activity concerns the biomass conversion to produce energy and bio-fuels, in particular Hydrothermal Liquefaction to produce bio-oil and gasification.

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Session reference: 2CV.4.10

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## On Thermal Decomposition of Biogas Digestate to Syngas

Short introductive summary:

The most favorable conditions for effective biogas digestate gasification is temperature range between 650 and 800°C at a residence time equal 10 minutes.

It leads to form high content of CO, CH<sub>4</sub> and H<sub>2</sub> in the gas generated.

Usability of an auger as device for continuous thermal processing was effective way for digestate gasification.

Presenter: **Stanislaw SZWAJA, Czestochowa University of Technology, Czestochowa, POLAND**

Presenter's biography:

Dr. Stanislaw Szwaja received his PhD from Czestochowa University of Technology in 1994, where he works as the associate professor. His research work has been concerning various problems on energy conversion, its impact on natural environment, energy storage and savings.

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Session reference: 2CV.4.12

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **MgO Modified Char Supported Catalysts for Dry Reforming of CH<sub>4</sub> - Preliminary Investigations for Valorization of Biomass-Derived Char as Active Catalysts**

Short introductive summary:

The current study is motivated by the need for valorization of char derived from biomass gasification. In this regard, we report the use of char as catalyst support for the dispersion of reaction active metals (nickel or cobalt) across its structure and its application in the dry reforming of methane (DRM) reaction. DRM is the catalytic conversion of CO<sub>2</sub> and CH<sub>4</sub> into syngas, which is a mixture of CO and H<sub>2</sub>.

In this work, we have reported the physico-chemical characteristics of char and the surface characterization results of the synthesized char-supported catalysts. The principal reason for such an application of char includes the ability to tune its physico-chemical properties (surface area, pore characteristics, acidity) similar to that of conventional catalyst supports like Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, TiO<sub>2</sub>, or activated carbon. This approach of char utilization could result in its valorization, which is otherwise wasted or has low commercial value.

Presenter: **Francesco PATUZZI, Free University of Bolzano, Faculty of Science and Technology, Bolzano, ITALY**

Presenter's biography:

Francesco Patuzzi received his PhD in 2014 and is presently assistant professor at the Faculty of Science and Technology at the Free University of Bozen-Bolzano (Italy). His research activities are mainly related to the study of thermochemical conversion of ligno-cellulosic biomasses.

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Session reference: 2CV.4.13

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Investigation of a Fluidised Bed Tar Reforming Reactor for Bio-SNG Applications

Short introductive summary:

### Background:

State of the art biomass gasifiers produce a syngas with certain amounts of unsaturated and polycyclic hydrocarbons (tars) that must usually be removed before the syngas can be used in catalytic or biologic conversions. This issue is known for many years and the most promising technology for tar removal is solvent washing (e.g. with biodiesel or RME). While this approach might be suitable for large-scale applications, it is not reasonable in small-scale, decentralized concepts. There, catalytic hot gas cleaning ("reforming") might be the preferred alternative for reducing the tar content in the syngas. Nevertheless, robust catalysts and reactor concepts need still to be developed.

### Approach:

At the Institute for Energy Systems the complete process from biomass to raw-SNG is built up in a small-scale demonstration test rig of 5 kW. It consists of an allothermal fluidised bed gasifier, hot gas cleaning and a fixed bed methanation reactor.

A new fluidized bed reactor for integration in the existing hot gas cleaning section is designed, constructed and used for the investigations.

Presenter: **Philipp JOHNE, Institute for Energy Systems, Technical University of Munich, Muenchen, GERMANY**

### Presenter's biography:

2010 - 2014 B.Sc. in Chemical Engineering at Technical University of Munich

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Session reference: 2CV.4.14

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



## CFD Simulation of Bio-Slurry Gasification Using a Sectional Approach

Short introductive summary:

Conversion of low-grade biogenic energy resources into high quality fuels is the overall goal of the bioliq project. The gasification of bio-slurry into syngas is a key process within this project. The modelling of the sub-processes involved, including evaporation, fuel oxidation and heterogeneous reactions, is very challenging. In order to generate data sets for process simulation, experiments are carried out at the Karlsruhe Institute of Technology using ethylene glycol as a surrogate for the pyrolysis oil.

The overall objective of the present work is to achieve fast and, at the same time, reliable CFD-simulations of these experiments using a novel method, the sectional approach, to describe the char gasification. In this method, virtual or pseudo-species defined by mass ranges and chemical composition are employed in order to represent the char particles. Therefore, a continuous description of the char behavior in the reactor has been chosen, in contrast to the usual discrete approach. In addition, an Euler-Euler approach has been chosen to model the slurry phase and the gas phase, facilitating the modelling of the char release during the liquid evaporation.

Presenter: **Quentin FRADET, German Aerospace Center (DLR), Institute of Combustion Technology, Stuttgart, GERMANY**

Presenter's biography:

2009 Baccalauréat, Lycée Guy de Maupassant, Fécamp, France

2009–2011 Classes Préparatoires aux Grandes Ecoles, Lycée Pierre Corneille, Rouen, France

2011–2015 engineering degree, Ecole Nationale Supérieure des Industries Chimiques, Nancy, France

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Session reference: 2CV.4.16

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Predicting Reactivity and Conversion Profile of Agro-Industrial Residues in Steam Gasification Processes: a Kinetic Approach**

Short introductive summary:

The object of this work is to develop a comprehensive investigation on the conversion kinetics of chars from agro-industrial residues in steam atmosphere, through the modeling of char-steam conversion, with the aim of predicting and simulating the conversion profile by means of the inorganic composition. The chars, object of this study, were obtained from Mediterranean agro-industrial residues, such as Citrus Pomace, Grape Pomace, Olive Pomace, Reed (Arundo Donax), and two lignin rich residues from 2nd generation bioethanol process, named as Reed Lignin and Straw Lignin. In short, the results of this work showed a way of predicting conversion and reactivity of agro-industrial residues with high ash content, both qualitative and quantitative, by means of the inorganic composition. Furthermore, the different roles of ash forming elements that mostly affect the kinetics was confirmed. The presented results are the first step for the design and the development of efficient gasification technologies for the energy exploitation of industrial residues that are different from wood, being of fundamental importance for this purpose.

Presenter: **Mauro PRESTIPINO, University of Messina, Engineering Dpt., Messina, ITALY**

Presenter's biography:

Researcher in the field of residual biomass gasification. Part of the research activity is focused on the kinetic study of biomass decomposition in H<sub>2</sub>O atmosphere. PhD degree at University of Messina, Department of Engineering.

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Session reference: 2CV.4.18

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Simulation of the Thermo-Chemical Conversion of Pruning of Apple Trees Using COCO Simulator

Short introductive summary:

COCO software was tested as a potential suitable tool to simulate the thermo-chemical conversion of pruning of apple trees. In order to avoid the limitation regarding the use of solids, a Matlab-unit was included to account for the heterogeneous reactions. Successively, the model was used to study the effect of the Temperature of reaction and Equivalence Ratio on the distribution of products in the producer gas and on the performance of the process by the assessment of the High Heating Value and the Cold Gas Efficiency. Finally, based on the developed model, the operating conditions of the gasifier were optimised.

Presenter: **Cristina MOLINER, University of Genova, Genova, ITALY**

Presenter's biography:

She got her PhD in 2016 by a co-tutored thesis at Università di Genova (UNIGE) and Universitat Politècnica de Valencia (UPV). She got her degree in Chemical Engineering in 2011 and her M.Sc. in Internal Combustion Engines in 2014 both at UPV. Her research is mainly on the field of biomass gasification

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Session reference: 2CV.4.19

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**CO<sub>2</sub> Gasification of Biochars Prepared from Agroindustrial Waste: a Kinect Study**

Short introductive summary:

Brazil is recognized as one of the largest agricultural producers in the world, consequently significant amounts of biomass in the form of agroindustrial wastes are yearly generated. Transforming waste into sustainable materials has become an imperative search for alternatives to avoid higher environmental pollution levels. In this context, the aim of this study was to evaluate the kinetic parameter of gasification process, under CO<sub>2</sub> atmosphere, of biochars produced by pyrolysis from castor bean cake and the mesquite pods bagasse, both agroindustrial wastes. The isothermal gasification of the biochars runs were performed in a thermogravimetric analyzer at atmospheric pressure. In terms of reactivity with CO<sub>2</sub>, the biochars from mesquite pods bagasse were more reactive than biochars of the castor bean cake, in the temperature range of 760-920 °C. The activation energy values related to biochars gasification were around 187-238 kJ·mol<sup>-1</sup>, where the theoretical kinetic model of random pore model proved more appropriate to represent the experimental data.

Presenter: **Humberto Horge JOSÉ, Federal University of Santa Catarina, Dep. of Chemical Engineering and Food Engineering, Florianópolis, BRAZIL**

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Session reference: 2CV.4.20

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Hydrogen from Biomass by Oxy-Steam Gasification - A Quantitative Analysis of Cases

Short introductive summary:

The work is on hydrogen production from biomass through oxy-steam gasification. Synthesis gas from gasification is made to pass through the separation unit to obtain hydrogen of 99.999% purity for utilization in fuel cells application. A separate experiment is also being reported to study the catalytic behavior of biomass char on water gas shift reaction for a possible positive effects on gasification process to enhance the hydrogen component in output gas.

Presenter: **Arvind GUPTA, IISc Bangalore, Bangalore, INDIA**

Presenter's biography:

PhD scholar working in the areas of biomass gasification and hydrogen production.

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Session reference: 2CV.4.22

Subtopic: 2.5 Gasification for synthesis gas production

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Marginal Land for Growing Industrial Crops: Turning a Burden Into an Opportunity

Short introductive summary:

The abstract is presenting a new research project that is being funded by H2020 and was started in July 2017. In its final version will present the work that will be carried out in the first year of the project with emphasis on the selection of the best industrial crops that can be cultivated on marginal lands as well as the first version of a database on industrial crops.

Presenter: **Efthymia ALEXOPOULOU, Center for Renewable Energy Sources, Biomass Dpt., Pikermi Attikis, GREECE**

Presenter's biography:

She is an agriculture engineer graduated from the Agricultural University in Athens (AUA) with PhD on the "Adaptability and biomass productivity of the non-food crop Kenaf in Greece". She is responsible for Energy Crops Unit in Biomass Department of Center for Renewable Energy Sources.

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Session reference: 1CO.9.1

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## **Phytoremediation Potential of Heavy Metal Contaminated Soils by the Perennial Energy Crops *Miscanthus* Spp. and *Arundo Donax* L. under Low Irrigation**

Short introductive summary:

In a previous study, it was found that giant reed and *Miscanthus* spp. yields were negatively affected when grown in heavy-metal contaminated soil under full irrigation (950 mm) to overcome water stress. However, both crops can be considered interesting candidates for heavy metals phytoextraction, based on the metal accumulation observed and the high biomass produced. In this work, the yields, the biomass quality and the phytoremediation potential of these perennials were tested but under low irrigation (450 mm). Giant reed biomass production was negatively affected by the Cr contamination, but not by the Zn or the Pb contamination. Zn contamination reduced significantly *M. x giganteus* production but not *M. sinensis* or *M. floridulus* yields. Biomass obtained in heavy metals contaminated soils presented higher ash content and higher Zn/Cr/Pb content than biomass from non-contaminated soils, thus showing phytoextraction and accumulation capacity. But, lowering the irrigation level reduced significantly the biomass production, causing lower accumulation of metals in the biomass.

Presenter: **Ana Luisa FERNANDO, Universidade Nova de Lisboa, Ciências e Tecnologia Biomassa Dpt., Caparica, PORTUGAL**

Presenter's biography:

Ana Luísa Fernando holds a PhD in Environmental Sciences. Assistant Professor at Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa. Main scientific areas: energy crops, remediation of contaminated soils, valorization of agro residues.

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Session reference: 1CO.9.2

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Summer Harvests Greatly Increase the Nitrogen Uptake of the Energy Grass Giant Reed

Short introductive summary:

There is currently great interest on using the perennial grass giant reed (*Arundo donax* L.) as partial substitute of maize for producing biogas. Such interest is due to the low agronomic input requirement and the high productivity of the species, which is also able to store nitrogen in the rhizomes at the end of the cycle, for the next season. For this type of utilization, giant reed can be harvested twice during the summer, due to plant regrowth ability. Little is known, however, about the effect of summer harvests on the nitrogen uptake of the crop. Because nitrogen fertilization is a crucial issue in the overall GHG balance of energy grasses, our study adds light on the sustainability of summer harvests for giant reed.

Presenter: **Enrico CEOTTO, CREA- Council for Agricultural Research and Economics, Research Centre for Agriculture and Environment, Bologna, ITALY**

Presenter's biography:

Enrico Ceotto is Senior Researcher Agronomist at the Research Center Agriculture and Environment, located in Bologna, Northern Italy. Currently, his research activity is focused on perennial energy crops and their ecosystem services. E-mail address: [enrico.ceotto@crea.gov.it](mailto:enrico.ceotto@crea.gov.it).

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Session reference: 1CO.9.3

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES



## Belowground Carbon Storage of Perennial Energy Crops: Implications for Re-Conversion to Arable Land

Short introductive summary:

Belowground storage of carbon in perennial energy crops is a pivotal element in the debate on their environmental sustainability. While an increasing body of literature is available on the effect of energy grasses and short rotation coppice on soil organic carbon (SOC), very little is reported on the fate of SOC during and after the re-conversion of energy crops to arable land. The main objectives of this research were to quantify for six perennial energy crops: 1) belowground carbon mitigation potential; 2) GHG balance of energy crops removal phases. The overall data picture on belowground C storage of energy crops, its differential contribution to CMP and its implications for GHG balance during reconversion to arable land will be discussed during the conference. This study provides a unique dataset that compares, in the same experimental site, the belowground C storage potential of the 6 most important perennial bioenergy crops. Furthermore, the assessment of the GHG balance relative to the crop removal phase provides original information to guide future LCA studies that cover the whole productive lifespan (from sowing to re-conversion to arable land).

Presenter: **Andrea FERRARINI, Università Cattolica del Sacro Cuore, Department of Sustainable Crop Production, Piacenza, ITALY**

Presenter's biography:

Andrea Ferrarini is a postdoctoral researcher at Department of Sustainable Crop Production (Università Cattolica del Sacro Cuore, Piacenza, Italy). Main expertise are focused on soil microbial ecology, terrestrial biogeochemical cycles, energy crops and sustainable agricultural practices.

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Session reference: 1CO.9.4

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## **Jatropha Cultivation in North African Countries: Results of Jatromed Project**

Short introductive summary:

JatroMed was a 5-year EU co-funded demonstration project focusing on the cultivation of the energy crop *Jatropha curcas* in three North African countries. In Egypt and Morocco, even though the plants received fertilization and irrigation and were healthy and well growing, the yields were quite low and far from the expected productions. In Algeria the plants could not survive the harsh climatic conditions of the demo site.

Presenter: **Eleni G. PAPAZOGLOU, Agricultural University of Athens, Crop Science Dpt., Athens, GREECE**

Presenter's biography:

Dr. Eleni G. Papazoglou is teaching and research associate at Agricultural University of Athens/Dept. of Crop Science. Her main scientific interests are on applied botany, non-food crops for exploitation and remediation of marginal & contaminated land, phytoremediation, energy crops

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Session reference: 1CO.9.5

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## **Towards EU-wide Harmonised Sustainability Requirements and Certification for All Bioenergy Sectors: Transport, Electricity and Heat**

Short introductive summary:

Advanced biofuels, also bioenergy for heat and power, use solid biomass as a feedstock. Systems producing advanced fuels are often multi output bio-refineries that produce bio-chemicals and biofuels, also generate heat and electricity. Currently, sustainability criteria for biofuels and bioliquids (mainly food-based biofuels) are proved through national systems or voluntary schemes (recognized by the European Commission). Sustainability requirements for solid and gaseous biomass fuels are limited to selected members including Belgium, the Netherlands, Denmark, and United Kingdom. Voluntary schemes have their own focus, national schemes have different level and inclusion of sustainability requirements, leading to varying sustainability requirements between countries, effectively discourage investors in bioenergy sector and cause administrative cumbersome.

Therefore EU-wide sustainability requirements for heat, electricity and transport sectors are needed to remove trade barriers and facilitate EU interconnected markets. This paper identifies possibilities of development and implementation of harmonised sustainability requirements and certification schemes at a EU level.

Presenter: **Thuy MAI-MOULIN, Copernicus Institute of Sustainable Development, Energy & Resources, Utrecht, THE NETHERLANDS**

Presenter's biography:

Thuy Mai-Moulin is a junior researcher at the Copernicus Institute, Utrecht University. Her works focus on sustainable

bioenergy supply chains, sustainability requirements for solid biomass use, as well as sustainable bioenergy trade and market to support the bio-based economy development.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 4CO.10.1

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **The Babet Real 5 Project - Setting the Scene for a Really Sustainable Second Generation (2g) Bioethanol Production in Bavaria**

Short introductive summary:

Can the production of 2G bioethanol be really sustainable when all parameters (i.e. soil carbon, climate change) that could have an influence on the potential biomass are thoroughly considered? When looking for agricultural residues that take into account all sustainability aspects, the available potential is reduced considerably. Still, it is possible to find promising regions and crops that make the sustainable production of 2G bioethanol possible. The results for 96 regions in Bavaria will be shown on GIS maps.

Presenter: **Ingo BALL, WIP Renewable Energies, Unit Bioenergy & Bioeconomy, Munich, GERMANY**

Presenter's biography:

Ingo Ball works as Project Manager at WIP Renewable Energies in the Biomass Department. He holds two degrees: Dipl. Sports Economist and B.Sc. Management of Renewable Energies.

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Session reference: 4CO.10.2

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Multi-Criteria Assessment of Sustainability Aspects of Bioenergy from Contaminated Land in the UK**

Short introductive summary:

Soil contamination is a widespread problem in Europe, bearing significant health and environmental risks. While phytoremediation has proven as an adequate approach in dealing with various contaminants little work has been done considering the bioenergy potential of contaminated site to remediate land, improve soil quality and health, recover elements and produce energy feedstocks. The UK has various sites, which are contaminated mainly with heavy metals from activities such as mining and application of sewage sludge and from landfill leachate. Within the Supergen Bioenergy Hub we will evaluate the full value chain of growing biomass on contaminated land, pre-treating and converting this biomass to energy and assess environmental, economic and social impacts.

Presenter: **Patricia THORNLEY, SUPERGEN Bioenergy Hub, Manchester, UNITED KINGDOM**

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Session reference: 4CO.10.3

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## On the Environmental Impacts of Food Waste: Case Study Results and LCA Methodological Challenges

Short introductory summary:

We applied consequential life cycle assessment (LCA) to quantify the environmental impacts of (avoidable) food waste and the burdens/savings associated with the involved waste management techniques. We included indirect land use change impacts associated with food production and we systematically assessed parameter and scenario uncertainties using state-of-the-art statistical approaches. Finally, we compared our results with the available literature and derived recommendations for improving food waste LCA studies.

Presenter: **Davide TONINI, European Commission, JRC, Lyngby, SPAIN**

Presenter's biography:

From 2017, I hold a position as Scientific Officer at JRC. From 2009-2017 I worked as a researcher at the Technical University of Denmark. I hold a PHD in Environmental assessment of waste and biomass systems and many scientific publications in the field of biofuel/bioenergy and waste management.

*Biographies and Short introductory summaries are supplied directly by presenters and are published here unedited*

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Session reference: 4CO.10.4

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Governance of Sustainability during the Different Market Phases of German Biogas Sector Development**

Short introductive summary:

At the 26th EUBC&E we will present preliminary results of our work derived from the IEA inter task study Measuring, governing and gaining support for sustainable bioenergy supply chains. Our focus is on sustainability governance in the different market phases of biogas market development in Germany with a view to other countries. Today more than 9,000 biogas plants are in operation in Germany using both, residues like manure and biowaste and energy crops as well. Based on Heuss (1965) four market phases for the German biogas sector development can be distinguished: (1) Introduction phase, (2) Expansion phase, (3) Maturing/Market integration phase, (4) Stagnation phase. Currently the German biogas market can be considered being in phase 3 of the approach mentioned above.

Presenter: **Thomas HORSCHIG, DBFZ-German Biomass Research Centre, Bioenergy Systems Dpt., Leipzig, GERMANY**

Presenter's biography:

Thomas Horschig. Work experience: 01/2014 - 10/2017 PhD Student @ DBFZ Deutsches Biomasseforschungszentrum. From 11/2017 on Research Fellow @ DBFZ Deutsches Biomasseforschungszentrum gGmbH, Leipzig. 2011 - 2013 University Halle-Wittenberg. M. Sc. Management of Natural Resources.

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Session reference: 4CO.10.5

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Development of Chromogenic True-to-Nature Biomass Substrates for Bioconversion Process Optimization**

Short introductive summary:

GlycoSpot is developing a range of new substrates for screening biomass quality and carbohydrate active enzymes' performance in biomass degradation in production of 2nd generation (2G) bio-ethanol, namely true-to-nature Insoluble Chromogenic Biomass (ICB) substrates. True-to-nature ICB substrates will have a high similarity to the original material in consistency, chemical composition and structure.

Because of this, they will provide:

- 1) information about substrate availability within the complex polymer mixtures typically encountered by enzymes in industrial contexts, and
- 2) a highly realistic impression of enzyme activity towards the complex biomass substrates. This provides a valid estimate of how the natural material that the ICB substrate was made from would behave in bioindustrial processing. The substrates are integrated with an industry standard 96-well filter plate format into a high-throughput, easy-to-use enzyme screening kit.

This project was funded by EUDP with 6 million DKK and GlycoSpot is working on this project in collaboration with Norwegian University of Life Sciences (NMBU) and Granbio, a Brazilian biotech company.

**Presenter: Stjepan Kresimir KRACUN, GlycoSpot, R&D, Frederiksberg C, DENMARK**

Presenter's biography:

Dr. Stjepan K. Kracun holds a M.Sc. degree in chemistry from the University of Zagreb, Croatia and a PhD degree in life sciences from the University of Copenhagen, Denmark. He specializes in bioorganic synthetic chemistry, biochemistry, method development and biotechnology.

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Session reference: 3CO.11.1

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Sustainability Analysis of Biorefining Schemes for Revalorization of Tequila Industry Residues and Wastes

Short introductive summary:

The tequila industry plays an important role in Western Mexico, economically speaking. However, residues and wastes are produced in considerable amounts, and both need proper treatment in order to mitigate their environmental impact. This paper provides an environmental and economic sustainability analysis of an integrated biorefinery which uses agave bagasse and vinasses to produce bioethanol and electricity from biogas, and compares it against process schemes for handling such residues separately.

Presenter: **Arturo SANCHEZ, Centro de Investigacion y de Estudios Avanzados del IPN, Bioenergy Futures Laboratory, Zapopan, MEXICO**

Presenter's biography:

(B.Sc. Chem. Eng., 1985; M. Chem. Eng., 1989; Ph.D., 1994). He is currently a Senior Scientist at Cinvestav-Gdl, Mexico. His research interests include advanced biofuels process engineering.

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Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Effect of Bark Content on Ethanol Production from Spruce Forest Residues - A Comparative Techno-Economic Analysis**

Short introductive summary:

The purpose of the work was to assess the influence of bark on the ethanol production process from different forestry assortments and to evaluate the economic feasibility as well as the future potential of utilizing forest residues with different bark content for ethanol production by comparing the cost of production through techno-economic analysis.

Presenter: **Balazs FRANKO, Lund University, Department of Chemical Engineering, Lund, SWEDEN**

Presenter's biography:

Motivated researcher at Lund University, Sweden awaiting defense of PhD in Chemical Engineering investigating biochemical conversion of biomass to bioethanol. Possess a keen interest in research, proficient laboratory skills, and a degree in biochemical engineering.

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Session reference: 3CO.11.3

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Improvement of Brewer´s Spent Grain Fermentation by Clostridium Beijerinckii DSM 6422 by in Situ Product Recovery**

Short introductive summary:

The production of butanol from fermentation of lignocellulosic hydrolysates is limited by product toxicity to the microorganisms, even at low concentration. This fact limits both yield and productivity of the process and constitutes one of the major challenges in biobutanol production. The use of in-situ gas stripping present many advantages over other separation methods, such as the simple operation, no harm to culture, does not requires any chemicals nor membrane and improves the agitation and homogenization of the fermentation broth.

This work present the preliminary tests of in-situ gas stripping for ABE fermentation of brewer´s spent grain (BSG) hydrolysates by Clostridium beijerinckii DSM 6422. The solvent concentration at the end of fermentation (taking into account butanol in the broth and in stripping condensate) was 18.1 g/L (13.5 g butanol/L).

**Presenter: Maria Teresa GARCIA-CUBERO, University of Valladolid, Chemical Engineering & Environmental Technology, Valladolid, SPAIN**

Presenter's biography:

Associate Professor at the Chemical Engineering and Environmental Technology Departmente (University of Valladolid) since 2001. The main field of research are the obtention of liquid biofuels (etanol and butanol) from lignocellulosic agroindustrial by-products residues.

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Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Scaling-Up Lignocellulosic Butanol Production (ButaNexT)

Short introductive summary:

The ButaNexT project aims to demonstrate the techno-economic feasibility of the conversion of two sustainable lignocellulosic feedstocks (wheat straw and miscanthus) available at EU level, into biobutanol through the integration of different technology. With regard to pilot plant assays, the integration of each individual process stage is being carried out gradually and the final objective is to validate the continuous performance in a 100 L fermenter coupled to a pervaporation unit in order to increase lignocellulosic sugars (C6 and C5) conversion and obtain higher butanol productivities. This presentation will show the final results from the project regarding the scale-up of ButaNexT process from lab to pilot scale.

Presenter: **Ines DEL CAMPO, CENER, Biomass Energy Dpt., Sarriguren, SPAIN**

Presenter's biography:

Ms Inés del Campo has a Msc in Chemical Engineer. Since 2002 she has been working in CENER Biomass Department as a Biomass Senior Researcher in Biomass Evaluation and Assessment and Biofuel Production projects. She worked before in CIEMAT Liquid Biofuels Group.

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Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Bringing Agro-Biomass to Reality: Keys for New Sustainable Value Chains Based on Agricultural Pruning and Plantation Removal Biomass**

Short introductive summary:

The utilization of agro-residues as a source of biomass is an opportunity for supporting the expansion of the bioeconomy in Europe. Among the multiple agro-residues, those produced from vineyards, olive groves and fruit plantation represent a relevant potential for many EU countries. Specifically the woody biomass residues from Agricultural Pruning and Plantation Removal (APPR from now onwards) is a paradigm of agro-residues being produced year after year, and in most of the cases, not utilized as a resource for added value activities like the production of energy, biochemical or other biocommodities. In this paper, the uP\_running project provides a vision to understand the current status of APPR biomass utilization in Europe and gives some recommendations for establishing new value chains based on this fuel. In addition, the document describes how to make the APPR biomass value chains a reality: how the different stages of the value chain and logistics can be carried out, which are the main keys to make the value chain operative, how to ensure that the final user finds an added value in the APPR biomass they receive, and how to preserve the quality and market value.

Presenter: **Emmanouil KARAMPINIS, Centre for Research and Technology Hellas, Chemical Process and Energy Resources Institute, Marousi, Athens, GREECE**

Presenter's biography:

MSc. Chemical Engineer. Research Associate at Centre for Research and Technology Hellas (CERTH) since 2006. Research areas include thermochemical conversion systems for solid biofuels, biomass co-firing, biomass logistics and sustainability assessment.

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Session reference: ICO.12.1

Subtopic: 6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)

Topic: 6. INDUSTRY SESSIONS

## **A Biomass Trade Logistic Centre for Biomass from Landscape Management - A Case Study in the Trasimeno Region (Italy)**

Short introductive summary:

The focus of the European greenGain project was to increase the use of the biomass from landscape management activities for energy and to investigate commercially viable pathways. This part of the work investigates a concept for a Biomass Trade Logistic Centre (BTLC) for lignocellulosic biomass in the Trasimeno region in Umbria, Italy. Typical data like capacities, product qualities, fuel consumption, cost and prices for processes, machinery used and necessary infrastructure have been validated with stakeholders at several meetings and workshops throughout the project duration.

Presenter: **Klaus LENZ, Syncom F&E Beratung, Research & Development Consulting, Ganderkesee, GERMANY**

Presenter's biography:

Dr. rer. nat. Klaus Lenz, received a PhD in physics from the Rheinische Friedrich Wilhelms University in Bonn, Germany in 1987. He is the managing director of the innovation consulting firm SYNCOM.

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Session reference: ICO.12.2

Subtopic: 6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)

Topic: 6. INDUSTRY SESSIONS

## **Utilization of Wood Resources in Biomass Heat and Power Plants in the Context of Market Developments**

Short introductive summary:

The development of wood use in biomass heat and power plants are shown in the context of market developments. The data are based on profound field research and on a continuous monitoring activity. The occurrence of subsidies is clearly related to the development of wood energy demand. The developments of material and energy uses are compared and their influence on prices is shown. The resource mix of BHPP varies over time. The energy use of wood is segmented into large and small Biomass Heat and Power Plants (BHPP) and compared with the consumption of private households. The information of the resource mix is a precondition for the valuation of sustainable wood use. In addition to the results in this abstracts regional supply and demand conditions will be presented.

Presenter: **Udo MANTAU, INFRO, Hamburg, GERMANY**

Presenter's biography:

Udo Mantau has been a Professor of forest economics at the University of Hamburg's Wood Science and Technology Centre since 1991. His scientific work focuses on resource information services. From 2018, Mantau will continue his research work with INFRO in a new location in the Harburger Channel area.

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Session reference: **ICO.12.3**

Subtopic: **6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)**

Topic: **6. INDUSTRY SESSIONS**

## Maximizing Utilization of Western Norway's Waste Resources - Addition of Aquaculture Waste into the Anaerobic Digestion of Municipal Sewage Sludge

Short introductive summary:

The circular economy concept is the baseline for the regionally funded Norwegian project, that has been initiated in 2017 by the research institute Aquateam COWI and representatives of municipal sewage agencies of Hordaland and Rogaland counties at Norway's west region. With the recent establishment of brand new biogas plants in both counties, which are centralized in the sense that they aim to treat the municipal sewage sludge produced at the regional wastewater treatment plants (wwtp), the joint project researches on:

i) the possibility and effects of co-digesting waste available from the salmon aquaculture sector with regional sewage sludge.

ii) production of bio-resources as byproducts during the anaerobic digestion process, i.e. organic acids, plant available nutrients and clean water.

First results obtained were promising for one of the sewage sludges tested. However, fish sludge samples coming from different aquaculture providers gave different range of improvement. Differences in the wastewater treatment process, and thus the sewage sludge quality, are detrimental on the expected effects regarding inclusion of a new substrate to a biogas plant.

Presenter: **Maria Magdalena ESTEVEZ, Aquateam COWI, Oslo, NORWAY**

Presenter's biography:

Chemical Engineer

Master in Environmental Technology and Management (Aalborg University, DK and De Montfort University, UK)

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Session reference: ICO.12.4

Subtopic: 6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)

Topic: 6. INDUSTRY SESSIONS



## **Innovative Double Loop Biogas Digestate Handling**

Short introductive summary:

Double loop handling of biomasse input turns societal wastes through a two-line biogas plant into fertilizer acceptable even for organic production in addition to the biomethane

Presenter: **Knud TYBIRK, Samsø Biogas, Samsø, DENMARK**

Presenter's biography:

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Session reference: **ICO.12.5**

Subtopic: **6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)**

Topic: **6. INDUSTRY SESSIONS**

### Case Study: Whey Valorization as Methane in a Two-Phase Process

Short introductive summary:

A two-phase process has been developed to convert whey to methane. The whey produced by an industrial dairy company in Ticino (CH) is currently co-digested in a standard CSTR process, used as reference to quantify the increased methane yield in the two-phase process.

To increase the methane yield, the hydrolysis/acidogenesis/acetogenesis (HAA) step of the AD process is physically separated from the final methanogenesis step in two reactors.

Data collected from lab scale tests have been used to design and realize an on-site pilot-scale plant to validate longterm the preliminary methane yields obtained.

Presenter: **Pamela PRINCIPI, SUPSI DTI MEMTI, Bio-Environmental technologies Lab, Manno, SWITZERLAND**

Presenter's biography:

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Session reference: 2CV.5.7

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Rapeseed Oil as Co-Substrate to Improve the Optimization of Anaerobic Co-Digestion Process in Semi-Continuous Regime**

Short introductive summary:

Biogas can be used energetically when the methane concentration is higher than 55 % to generate thermal energy. Elevated methane yields are essential to get an optimum use as a gaseous biofuel. Rapeseed oil is chosen as co-substrate to enhance the methane production in anaerobic co-digestion process due to its high carbon content. However this substrate has a raised lipid content that can lead to inhibition in the process. For this reason it is necessary to establish the adequate ratio of the substrates employed. Based on the information available the main objectives of this work are the optimisation of an experiment for co-digestion anaerobic in semi-continuous regime with elevated methane concentration in biogas generated and the reproducibility of this experience on a larger scale.

Presenter: **Ana Isabel PARRALEJO ALCOBENDAS, Cicytex, Guadajira, SPAIN**

Presenter's biography:

My studies are Chemical Engineering and Materials Engineering. I work in CICYTEX 7 years ago for the same department developing laboratories works and scientific reports, collaborating with companies to promote the applied research.

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Session reference: 2CV.5.12

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Effect of Combined Pretreatment on Solubilization and Biogas Production from Scenedesmus Biomass

Short introductive summary:

In this study, Scenedesmus biomass was subjected to ultrasonic (U1) and/or enzymatic pretreatment (E1, E2). In addition, combined pretreatment (C1, C2) was also applied with both ultrasonic and enzymatic pretreatment prior to anaerobic digestion. The solubilization results showed that carbohydrate and protein solubilization was enhanced with after all types of pretreatment. In terms of carbohydrate, highest carbohydrate solubilizations were observed for C1 and C2. It was also observed that when compared to U1, E1, and E2, carbohydrate solubilization were further improved for both combined pretreatments (C1 and C2). In terms of proteins, increase in protein solubilization was observed as highest for C2. BMP tests also indicated that highest increase in biogas production was observed for combined pretreatment with higher dose (C2) as 110% (157.7 ml CH<sub>4</sub>/g COD). Therefore, this study showed that application of combined pretreatment methods enhanced protein and carbohydrate solubilization and biogas production from Scenedesmus biomass when compared to mono pretreatment methods.

Presenter: **Ece KENDIR, Hacettepe university, Environmental Engineering, Ankara, TURKEY**

Presenter's biography:

B.S.degree(2010) and M.S degree (2013): Department of Environmental Engineering, METU, Turkey, M.S. thesis: Health risk assessment of land application of biosolids

PhD (ongoing): Department of Environmental Engineering, Hacettepe University, Turkey: Enzymatic pretreatment of algae for improved biogas production

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Session reference: 2CV.5.21

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Anaerobic Digestion of Algal Residues after a Supercritical Carbon Dioxide Extraction

Short introductive summary:

Due to the high production costs of microalgae the sole production of energy via anaerobic fermentation is economically not feasible at the moment. Therefore, a combination of a supercritical extraction and an anaerobic digestion could be performed to extract high-value products, such as omega-3 fatty acids, and utilize the algal residues for biogas production. In this work the anaerobic digestion of the microalgae *Nannochloropsis salina* after a supercritical extraction of fatty acids was investigated.

The experiments show that the combination of a supercritical extraction of oils with an anaerobic digestion of the algal residues is beneficial for the biogas yield. Though semi-continuous tests indicate that a mono-digestion is not possible. The low carbon/nitrogen ratio leads to an accumulation of ammonium and an inhibition of the anaerobic digestion. A co-digestion with substrates with a high carbon/nitrogen ratio and a high water content would be necessary to establish a stable process.

Presenter: **Eugen SPIELMANN, Ruhr-Universität Bochum, Lehrstuhl für Thermodynamik, Bochum, GERMANY**

Presenter's biography:

Eugen Spielmann is a PhD student in the biogas group of the chair of thermodynamics at Ruhr-University Bochum. He received a B.Sc. and a M.Sc. in mechanical engineering at Ruhr-University Bochum.

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Session reference: 2CV.5.25

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Anaerobic Digestion of Different Organic Feedstocks by Continuous Bioreactors

Short introductive summary:

Anaerobic digestion of different kind of organic feedstocks is an important part in recycling of waste resources and producing bioenergy. Materials used for wet and dry digestion processes affect essentially to methane production rates. In this study methane production rates of different mixtures of raw materials (forage, cattle manure sludge and sludge produced in wastewater treatment processes) were investigated by using continuous 15 L anaerobic digestion reactors. Reactors were run for 250 days and same time biogas and methane production rates, pH, alkalinity, C:N ratio and total nitrogen were followed. In both reactors biogas and methane production rates varied based on OLR and HRT values. During active phases of run biogas production varied from 423 to 870 mL/gVSd (avg.) for mixture of membrane bioreactor (MBR) sludge and forage and from 327 to 769 mL/gVSd (avg.) for mixture of cattle manure sludge and forage. Amount of methane in biogas varied from 47 to 54 % for mixture of MBR sludge and forage and from 48 to 59 % for mixture of cattle manure sludge and forage, respectively.

Presenter: **Heikki SÄRKKÄ, South-Eastern Finland University of Applied Sciences, Forest, the environment and energy, Mikkeli, FINLAND**

Presenter's biography:

Dr. Sc. (Eng.) Heikki Särkkä is working as a project manager at South-Eastern Finland University of Applied Sciences. His research interests are mainly in biogas production from secondary raw materials and developing novel wastewater treatment technologies.

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Session reference: 2CV.5.28

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Developing Technique Anaerobic Digestion in The Context of Renewable Energy Sources

Short introductive summary:

Incorporation into the production cycle of an installation for directing the entire flow of slurry from the channels under the grate barn or pigsty to operating as a flow reactor, which will occur methane fermentation, allows for pure biological fertilizer. Thus, in addition to its energy in the form of electricity and heat, an application will be possible in the field of value ecologically and dropwise-creative fertilizer. This setup will also meet the criteria for the implementation of sustainable production in farms engaged in livestock production.

Presenter: **Grzegorz WALOWSKI, INSTITUTE OF TECHNOLOGY AND LIFE SCIENCES, Department of Renewable Energy Resources, Poznan, POLAND**

Presenter's biography:

Grzegorz Walowski -Assistant professor (Adiunkt) in Institute of Technology and Life Sciences in Falenty, Department of Renewable Energy Resources Branch in Poznan, (since 10.2016).

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Session reference: 2CV.5.29

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Boosting Biogas with Hydrolytic Enzymes - Effect of Cellulase Pretreatment of Wheat Straw on Sugar Release, Onset and Ultimate Gas Production**

Short introductive summary:

Summary: In biogas reactors, hydrolysis of fibrous substrate can be improved by supplementing hydrolytic enzymes, however, reports are not conclusive on this claim. In this study, two commercial preparations consisting of cellulases and hemicellulases, were characterized and tested for their effect on biogas yield. Milled wheat straw was incubated with enzymes in a pretreatment step, prior to mixing with cow's manure. Following anaerobic digestion (AD), improved gas yield and increased volatile fatty acids (VFA) was demonstrated in small scale syringe reactors (100 ml) under various conditions. As a further verification, enzyme pretreatment and AD was scaled up (1.5 L) with optimized conditions. Monitored for extended time, both enzyme-treated reactors performed 16-23% better on gas yield compared to control. Although the increased release of fermentable sugar shortens lag time and lowered volatile solids (VS), enzyme hydrolysis can also cause microbial imbalance compromising reactor pH due to rapid acid accumulation.

Presenter: **Knut Olav STAETKVERN, Inland Norway Univ. of Appl. Sci., Dep. of Biotechnology, Hamar, NORWAY**

Presenter's biography:

1985 Civil Engineer University of Trondheim, Technical Biochemistry

1991 DSc. University of Bergen in Experimental biochemistry

1992 - present: Professor at Inland Norway University of Applied Sciences, Hamar.

1997 and 2006 Visiting professor/ scientist at NDSU, ND and UMES, MD

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Session reference: 2CV.5.31

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



## **Influence of Mixing on the Process Stability of Anaerobic Digestion**

Short introductive summary:

To investigate the influence of mixing on the process stability of anaerobic digestion, corn silage was digested in a continuously mixed reactor and in an intermittently mixed reactor. The intermittently mixed reactor was only mixed around feeding. All reactors were fed daily with a high organic loading rate (OLR). Biogas quantity, methane content, pH value, volatile fatty acids (VFA), VFA/TIC ratio (TIC – total inorganic carbon), total solid content (TS) and volatile solid content (VS) were analyzed.

While the methane content and pH value of both reactors were similar within the measurement uncertainties, the degradation rate of the input substrate and the daily specific biogas production were significant higher for the intermittently mixed reactor. Regarding VFA concentrations and VFA/TIC ratio, the continuously mixed reactor showed a process failure, while the intermittently mixed reactor operated stable.

Intermittent mixing improved process stability and reduced energy consumption dramatically. However, intermittent mixing led to a higher digestion volume due to swelling.

Presenter: **Eugen SPIELMANN, Ruhr-Universität Bochum, Lehrstuhl für Thermodynamik, Bochum, GERMANY**

Presenter's biography:

Eugen Spielmann is a PhD student in the biogas group of the chair of thermodynamics at Ruhr-University Bochum. He received a B.Sc. and a M.Sc. in mechanical engineering at Ruhr-University Bochum.

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Session reference: 2CV.5.32

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Monitoring the Mixing of an Artificial Model Substrate in a Scaledown Laboratory Digester

Short introductive summary:

Investigating the mixing process in digesters is a necessary precursor for successful design, operation, and increased efficiency in biogas plants. However, observation of mixing in digesters under real conditions is complex and cost intensive. Based on the theory of similarity, a 1:12 scale digester model is set up (see in the figure the photo of the side view and the scheme of the top view) and an artificial chemical substrate is selected to mimic the rheology of real biomass. Different mixing regimes are configured using propellers and paddle stirrers located in various positions. Optical and acoustic techniques are employed to observe the fluid dynamics. Within the present work, the laboratory setup and the principal results of the flow velocity, power consumption and torque developed during mixing are presented and discussed. The experimental results, which illustrate the digester mixing quality in various propeller and stirrer configurations, are used to validate a numeric computational fluid dynamic based study.

Presenter: **Mirco LORENZON, University of Padova, Department of Biology of the university of Padova, Treviso, ITALY**

Presenter's biography:

I graduated in Biotechnology at the University of Padova in September 2017, achieving a score of 101 over 110, with the thesis Molecular biology techniques in biogas production from organic compounds. . I am now attending at the same university the Master in Industrial Biotechnology.

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Session reference: 2CV.5.34

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Biotechnology to Investigate the Biogas-Producing Microbial Community in Biomass

Short introductive summary:

In this study we analyze the application of biotechnology in the biogas production. We focus on the characterization of microbial composition in the organic matter, feedstock in the biogas plant. The aim is to optimize the process, directly modifying the organisms that catalyze it. In the present work we cite examples of these biotechnological approaches and the difficulties encountered in the analysis of the microbiome itself.

Presenter: **Martina TRENTINI, University of Padua, Trento, ITALY**

Presenter's biography:

I Graduated in Biotechnology in the year 2017 at the university of Padova, achieving a score of 108 over 110. My thesis is about the role of thermophilic bacteria in the production of biogas and the influence of temperature in the process.

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Session reference: 2CV.5.35

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Effects of Thermal Hydrolysis Pretreatment on Physicochemical Properties of Wastewater Sludge and Enhancement of Biogas Production Potential**

Short introductive summary:

This study aims to minimize the negative impact of sludge waste on the environment and simultaneously reduce organic sludge waste and bring economic benefits in the use of renewable energy sources. A number of individual studies in the use of thermal hydrolysis pretreatment (THP) on waste sludge characteristics have been done. However, it has many limitations and gaps in the application that require further studies to optimize the performance of anaerobic digestion process, such as incomplete decomposition of organic matter, limited rates of methane production, low biogas production and methane content, long start up time, require large quantities of sludge seeding, sensitivity to accumulation of VFA and toxic compounds, and small changes in the operating parameters (temperature, pH, OLR, nutrient, etc.). Hence, this study aims to overcome the aforementioned issues, as well as to improve the efficiency of anaerobic digestion. In addition, this study also provides the optimal parameters in the design, installation and operation of the sewage sludge thermal hydrolysis pretreatment system for retrofit or new plants on project, and creates the opportunity for the sought-after

Presenter: **Soon Woong CHANG, Kyonggi University, Department of Environmental Energy & Engineering, Kyonggi, REPUBLIC OF KOREA**

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Session reference: 2CV.5.37

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## On the Effect of the Particle Size And its Relationship with Gas Production

Short introductive summary:

Particle size is important parameter which needs to be looked from different point of views such as energy consumption and efficiency of whole process. this work is a first step in the direction

Presenter: **Ravi DHAVALESWARAPU, Indian Institute of Science, Centre for Sustainable Technologies, Bangalore, INDIA**

Presenter's biography:

I am a research scholar at the Indian Institute of Science. I work in the area of biomass and bioenergy. My sub-specialty is in the area of biomass to biogas conversion. I am also interested in the area of biomass to liquid fuel conversion.

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Session reference: 2CV.5.40

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Trace Sulphur and Organic Compounds in Biogas from Different Biomass Sources

Short introductive summary:

In order to design robust systems for gas cleaning and energy conversion, information is needed about which compounds exist in biogas from different sources. Our group has built up a toolbox of sampling and analytical equipment for biomass-derived gases (gasifier gas and biogas). This toolbox is used to identify and quantify trace compounds sampled at different biogas sites in Switzerland. The sites sampled include a wastewater treatment plant digester, a biowaste digester, and agricultural sites using manure as the primary feedstock. Many more trace sulphur compounds originate from the biowaste digester than from the wastewater treatment plant biogas. Meanwhile, siloxanes are absent in the biowaste gas but present in the wastewater gas, while the biowaste gas contains terpenes to a much greater extent than the wastewater gas does.

Presenter: **Serge BIOLLAZ, PSI - Paul Scherrer Institut, Thermal Processes & Combustion, Villigen PSI, SWITZERLAND**

Presenter's biography:

Education: Master and PhD from ETH Zürich as Mechanical Engineer

Actual Position: Head of a research group at PSI

Research interest: Biomass gasification and Biogas for electricity and biomethane generation

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Session reference: 2CV.5.41

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Anaerobic Digestion Enhancement via Bioaugmentation of the Microbial Community: an Application to Shrimp Processing Waste

Short introductive summary:

The aim of the study was to compare biogas obtained from shrimp processing waste, by applying several bioaugmentation conditions, both to reduce H<sub>2</sub>S concentration and to increase CH<sub>4</sub> amount and concentration. Hydrolytic Anaerobic Ruminant Fungi (ARF) and/or a Fermenting acidogenic bacteria pool (F210) were added to the methanogenic community with the aim of enhancing Anaerobic Digestion (AD) process efficiency. Batch tests (1,2 L reactors) were carried out in mesophilic conditions, with a substrate concentration of 13.0 gVS/L, using different inocula concentrations (8% or 16%). Biogas production and composition (H<sub>2</sub>S and CH<sub>4</sub>) were detected, as well as the main intermediate products (Volatile Fatty Acids or VFAs) into the culture medium. By the 30th experimental day, Sulphurous Species Concentration (SSC) was also detected. Main microbial community characteristics and Sulphate Reducing Bacteria (SRB) occurrence, were investigated by fluorescence microscopy techniques and related to the AD process performances.

Presenter: **Nadia CERONE, ENEA Research Centre, Technical Unit for Trisaia Technologies, Rotondella, ITALY**

Presenter's biography:

Senior researcher at ENEA in development of technologies and processes of energy exploitation of biomass for electricity and biofuels. Expert of pyrolysis and gasification plants; hydrogen separation, LCA and project management.

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Session reference: 2CV.5.42

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Sequential Anaerobic Co-Digestion of Chicken Litter with Agro-Industrial Wastes in Semi-Solid Conditions and Comparison with Their Wet Anaerobic Digestion Performances**

Short introductive summary:

Anaerobic digestion (AD) has received growing attention, as a renewable and eco-friendly technology, for the management of solid organic wastes. In Victoria, Australia, the agro-industries, produces large quantities of solid wastes such as the poultry industry which produces around 0.4 million tonnes per year of chicken litter (CL) as well as other solid wastes such as organic fraction of municipal solid wastes and agricultural residues. In Australia, it is difficult to find scientific knowledge directly applicable to these wastes. CL has high biochemical methane potential, however, AD of CL is suitable to inhibition due to the high level of protein and amino acid mostly at high solid conditions. Because of the nature of the wastes, it is mostly suitable for high solids to dry AD to reduce the digester volume, water requirement, and operating cost and post digestion managements. The co-digestion of CL with other agro-industrial wastes at a balanced C/N ratio could be utilised to control inhibition. This study focuses on chicken farms and aims to investigate the potential of CL and other agro-industrial wastes, from the neighboring area available for a high solid AD.

Presenter: **Zubayeda ZAHAN, RMIT University, Civil Environmental and Chemical Eng, Melbourne, AUSTRALIA**

Presenter's biography:

Zubayeda Zahan is working toward the PhD degree in Environmental Engineering, RMIT University, Melbourne, Australia. Her research interests include wet and dry anaerobic digestion, municipal wastewater treatment, lignocellulosic pre-treatment, manure and solid wastes co-digestion.

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Session reference: 2CV.5.43

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



## **Fresh Bovine Manure Standardization to Start Up Anaerobic Digestion in a Low-Cost Biodigester**

Short introductive summary:

The purpose of this work was to study the characteristics of fresh bovine manure -BM- for AD and the best conditions of temperature, agitation and nutrient supply, to establish a protocol to start-up an anaerobic reactor at a laboratory scale and transferring those conditions to a low-cost biodigester located in a farm.

Presenter: **Mabel QUINTERO, Universidad Industrial de Santander, Santander, Bucaramanga, COLOMBIA**

Presenter's biography:

I work in anaerobic digestion processes and generation of alternative energies from agricultural, livestock, industrial and FORSU waste. My experience focuses in the analysis of microbial populations present in inoculums and determination of the metabolic activities of these.

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Session reference: 2CV.5.49

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Anaerobic Digestion of Waste of Coffee Production and Damaged Sunflower Seeds

Short introductive summary:

A study was carried out using laboratory equipment to find out the potential of biogas from waste of coffee production and damaged sunflower seeds and as a biogas production process affected by adding biocatalyst Metaferm. Raw materials were fermented into 16 bioreactors at 38 °C in a single filling system, taken waste from the Kekava coffee factory. On average, digestion during 40 days yielded 0.205 l / gdm biogas (0.089 l / gdm methane) from coffee production waste and 0.251 l / gdm biogas (0.099 l / gdm methane) when added 1 ml Metaferm. 0.916 l / gdm of biogas (0.574 l / gdm of methane) were obtained from crushed damaged sunflower seeds and 0.906 l / gdm biogas (0.554 l / gdm of methane) were obtained from non-crushed damaged sunflower seeds. The study shows that it is possible to extract a small amount of methane from the coffee production waste, but taking into account the high proportion of dry matter in natural biomass, the use might be useful. The addition of Metaferm increased the methane yield. Larger methane yields from crushed damaged sunflower seeds.

Keywords: biogas, methane, biomass, anaerobic fermentation, digestate.

Presenter: **Imants PLUME, Latvia University of Agriculture, Institute of Agricultural Energetics, JELGAVA, LATVIA**

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Session reference: 2CV.5.52

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## The Role Of Biogas in the Future Danish Energy System

Short introductive summary:

Denmark has a large agricultural production that can provide substantial biomass resources for biogas production. This study has analyzed the potential biogas production and the related GHG emission reductions based on all Danish agricultural side-streams and organic waste sources under different scenario assumptions. The study describes a resource flow from biomass resources to potential biogas production, and related GHG emissions. There are two agricultural biomass scenarios based on the "Environmental optimized scenario" of the +10 mio. tonnes study: a low and high biomass scenario. There are three biogas technology scenarios: (1) State-of-the-art biogas plant where biogas is upgraded to biomethane by conventional methods (2) Environmental-optimized plant with prolonged retention time (3) Environmental-optimized plant where methanisation of CO<sub>2</sub> in biogas is implemented. We found that between 23 and 42 PJ gross energy in biogas can be produced in the low biomass scenarios, while in the high biomass scenario between 59 and 107 PJ gross energy can be produced depending on the technologies applied.

Presenter: **Henrik MøLLER, Aarhus University, Engineering, Tjele, DENMARK**

Presenter's biography:

Henrik B. Møller is senior researcher at department of Engineering (AU-ENG) and has 25 years experience with research and development of the biogas technology. His research area covers most aspects of biogas including pre-treatment, process optimisation and environmental aspects.

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Session reference: 2CV.5.58

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Producing Drop-In Fuels from Swine Manure: Hydrothermal Liquefaction and Biocrude Hydrotreating**

Short introductive summary:

Processing waste biomass with a high moisture content is one of the key-aspects of hydrothermal liquefaction (HTL). A by-product such as swine manure can be thus converted into bio-crude. To meet the standards of commercial fuels, bio-crude can undergo hydrotreatment through the reaction with pressurized H<sub>2</sub> over a catalyst. Many works in the literature deal with the upgrading of wood-derived bio-crudes, for which the main point is the removal of oxygen. When operating with manure, the removal of nitrogen becomes a crucial issue, which must be addressed in order to produce a drop-in fuel. In the present work, the whole process of continuous bio-crude production from swine manure and subsequent hydrotreating is presented. A methodology based on micro-batch reactors (25 mL) is adopted, allowing exploring a large number of process conditions and selecting the optimal ones. The fate of nitrogen and the yields of the different fractions in the bio-crude are investigated. Finally, single-point distillation is adopted in order to hydrotreat only the lighter fraction of the bio-crude. This potentially improves the quality of the product and contains the H<sub>2</sub> uptake of the process.

Presenter: **Daniele CASTELLO, Aalborg University, Dept. of Energy Technology, Aalborg Øst, DENMARK**

Presenter's biography:

Ph.D. in Environmental Engineering at the University of Trento (Italy), then post-doctoral fellow at the University of Twente (Netherlands). Currently, post-doctoral fellow at Aalborg University (Denmark) in the field of bio-crude upgrading to drop-in fuels.

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Session reference: 3CV.6.1

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Formation of Nitrogen-Containing Heterocycles during Hydrothermal Liquefaction of Model Compounds and Sewage Sludge**

Short introductive summary:

The analysis of chemical composition in bio-crude as well as the fate of nitrogen in HTL of model compounds is necessary not only for evaluating the bio-crude as fuel feedstock, but also for clarifying the mechanism of HTL. The objective of the study is to identify the compounds present in the bio-crude with a particular attention to the N-containing heterocycles, expecting to provide a better understanding about the mechanism of Maillard reaction pathways through HTL of protein contained biomass.

Presenter: **Yujie FAN, Karlsruhe Institute of Technology, Institute of Catalysis Research and Technology, Eggenstein-Leopoldshafen, GERMANY**

Presenter's biography:

I am a PhD student, studying chemical and process engineering at Karlsruhe Institute of Technology in Germany. I research bio-crude products from hydrothermal conversion since 2013, published 7 papers. Current topic focuses on the bio-oil yields and quality via hydrothermal liquefaction.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 3CV.6.4

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Simultaneous Production of Biocrude Oil and Recovery of Nutrients Through Hydrothermal Liquefaction of Organic Wastes**

Short introductive summary:

Hydrothermal Liquefaction (HTL) is a promising technology for the production of alternative fuels. An energy dense biocrude oil is produced from thermochemical conversion of biomass under sub or super critical water conditions. Even wet biomass can be processed with no need for expensive drying pre-treatments. In order to produce cost-competitive renewable fuels, low-value products should be used as feedstock. Therefore, the great amount of organic waste produced from animal farming activities represents an attractive feedstock for the HTL process. In the present study, animal manure, digestate from anaerobic digestion, and aquaculture sludge from fish farming activities are individually processed under supercritical conditions (400°C, ~300 bar) in micro-batch reactors. Products yield are assessed and the quality of the biocrude is investigated. Manure, digestate, and fish sludge are waste products, but also a source of nutrients, which, through the HTL process, can be recovered in the products. The fate of the inorganics after HTL processing is here investigated, and the distribution of nutrients and metals among the different products is outlined to assess their recovery.

Presenter: **Federica CONTI, Aalborg University, Energy Technology, Aalborg, DENMARK**

Presenter's biography:

With a university background in Process and Chemical Engineering, I am currently working at Aalborg University on hydrothermal processing of various biomass feedstocks and residual organic fractions for biofuels and chemicals production.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 3CV.6.5

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Sewage Sludge Filtration Employing Biomass Filter Aid with Subsequent Fuel Production via Hydrothermal Liquefaction**

Short introductive summary:

Hydrothermal liquefaction (HTL) is a promising technology for biofuel production and treatment of wastewater sludge. We present a novel process of combining lignocellulosic filter aids to increase the dry matter content of sludges and subsequently produce bio-crude from their combination.

Presenter: **Patrick BILLER, Aarhus University, Aarhus, DENMARK**

Presenter's biography:

Patrick got his PhD at the Energy Research Institute, University of Leeds in 2013. After his PhD he obtained a EPSRC fellowship in Leeds. In 2015 he started a post-doc position at Aarhus University, then as a Marie Curie Co-fund fellow and now as an Assistant Professor at the Department of Engineering

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 3CV.6.6

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

### **A Study of Reaction Pathways in Formic Acid Assisted Hydrothermal Conversion of Lignin Using <sup>13</sup>C Enriched Reactants and NMR Analysis**

Short introductive summary:

Summary: <sup>13</sup>C-enriched formic acid (FA) and <sup>13</sup>C NMR have been used in FA assisted hydrothermal conversion of lignin to show the incorporation of carbon from FA into the bio-oil as carbonyl and carboxyl groups. Knowledge of the depolymerisation mechanism will support optimisation of the lignin processing for high yields at less severe conditions.

Presenter: **Tanja BARTH, University of Bergen, Chemistry Dpt., Bergen, NORWAY**

Presenter's biography:

Tanja Barth is professor at the Department of Chemistry, University of Bergen, Norway. Her research addresses thermochemical biomass conversion for biofuel and chemicals production in an organic chemistry perspective, in parallel with and studies on petroleum composition and alteration.

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Session reference: 3CV.6.7

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



**Wet Partial Oxidation of Guaiacol into Carboxylic Acids using Hydrogen Peroxide**

Short introductive summary:

Vast amounts of lignin end up as by-product in aqueous streams of Kraft pulping and lignocellulosic bioethanol processes. Its conversion into valuable chemicals is one of the key factors for increasing the competitiveness of these processes. A few studies have shown that lignin can be converted into mono- and dicarboxylic acids (MCA, DCA) by means of partial oxidation at hydrothermal conditions (Wet Partial Oxidation, WPO). The production of MCA/DCA from lignin by-products can open up to the integration of the above-mentioned processes with anaerobic digestion units for production of biomethane and/or downstream separation of MCA/DCA, which are important chemicals. However, the current knowledge does not allow directing and controlling the WPO of lignin towards the desired products and further studies on lignin and on lignin model compounds are deemed necessary. This work investigate the WPO of guaiacol, a 1-ring aromatic species that is produced in lignin depolymerization. Reactions were carried out within 150 and 300 C, at 100 bar, with an oxygen supply of 40%. Yields of MCA/DCA up to 19% have been obtained so far.

Presenter: **Viken Márk KAPRIELIAN, Aalborg Universitet, Esbjerg V, DENMARK**

Presenter's biography:

Scientific assistant (01/10/2017-15/12/2017)

Masters in Oil and Gas Technology (2015 - 2017) Aalborg Universitet

Masters in Chemical Engineering, Budapest University of Technology and Economics (2013-2015)

Bachelor in Chemical Engineering, Budapest University of Technology and Economics (2009-2013)

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Session reference: 3CV.6.8

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Influence of Hydrothermal Pre-Treatment on Biofuel Production from Microalgae**

Short introductive summary:

This work contributes to the growing body of research investigating the conversion of oil containing oleaginous biomass, such as microalgae, into high quality biofuels and in particular, investigates using low temperature hydrothermal conversion as a pre-treatment to downstream biofuel conversion. Microalgae cultivated under both phototrophic and heterotrophic conditions is investigated. Conversion of the hydrothermally treated residue can be performed by either pyrolysis, solvent extraction or hydrothermal liquefaction.

**Presenter:** **Iram RAZAQ, University of Leeds, School of Chemical and Process Engineering, Leeds, UNITED KINGDOM**

Presenter's biography:

I have a BSc in Environmental Science from the University of Bradford and an MSc in Energy and Environment from the University of Leeds. I am currently in my 3rd year of an interdisciplinary MSc/PhD in the Doctoral Training Centre for Bioenergy at the University of Leeds.

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Session reference: 3CV.6.9

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Hydrothermal Liquefaction and Partial Oxidation of Microalgae

Short introductive summary:

Because of the high amount of water in micro algal biomass, hydrothermal liquefaction is particularly appropriate for its conversion into liquid fuels. An additional process is proposed by using partial oxidative conditions in order to increase the formation of some recoverable products. Experiments are carried out in a batch reactor (10-30 MPa, 473-623 K). After the reaction, remaining phases are recovered and analyzed. A particular attention is paid to the influence of microalgae composition.

Presenter: **Tsilla BENSABATH, Université d'Aix-Marseille, M2P2, Aix en Provence, FRANCE**

Presenter's biography:

Tsilla Bensabath is a research and teaching assistant at the University of Aix-Marseille (France). She has an engineer's degree in process engineering. She supported her PhD in 2017 on a preventive approach for a reduction of PAHs in pyrolysis furnaces at the University of Lorraine (France).

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Session reference: 3CV.6.10

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

## Hydrothermal Liquefaction of Algae

Short introductive summary:

The Authors would like to present this study that explores the influence of reaction atmosphere and the presence of in-situ heterogeneous catalysts on the composition/quality of HTL treated macro- and microalgae species. Hydrothermal liquefaction experiments –performed in a batch 25 ml high-pressure reactor– revealed that microalgae feedstocks produced a visible oil product (bio-crude).

The microalgae species were either cultivated in a 600 L Aston EBRI BioFence reactor or obtained from Aston University European Bioenergy Research Institute industrial partners, and they include: *Isochrysis galbana* (T-ISO), *Arthrospira platensis* (Spirulina) and *Nannochloropsis gaditana*. The macroalgae species: *Himanthalia elongata*, *Ascophyllum nodosum*, *Fucus serratus*, *Fucus vesiculosus* and *Ulva lactucabiomass* were provided by Plymouth Marine Laboratory (UK).

Nutrient recycling has been identified to aid in the economic viability of algae derived bio-fuels as the aqueous residues were found to contain high amounts of nitrogen and are anticipated to contain macronutrients needed for the cultivation of algae.

Presenter: **Daniel J. NOWAKOWSKI, Aston University, CEAC / BERG, Birmingham, UNITED KINGDOM**

Presenter's biography:

Not relevant at this moment.

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Session reference: 3CV.6.11

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

**Production of High Quality Biocrude from Rice Straw via Hydrothermal Liquefaction**

Short introductive summary:

Hydrothermal liquefaction (HTL) is a promising one as it can be used to process the wet biomass, and still yield low oxygen containing bio-crude. HTL has some of the advantages compared to the fast pyrolysis. HTL process is suited for wet biomasses; hence there is no necessity for biomass drying. High energy efficiency and low oxygen content in the biocrude are the salient aspects of HTL compared to fast pyrolysis. In this study, HTL of rice straw was investigated at different operating parameters for production of high quality biocrude. The optimum conditions to maximize the yield and quality of biocrude were found to be 300°C, 180 bar, 1:10 (wt./wt.) biomass: water content, 60 min of reaction time. This corresponds to biocrude yield of 12.3 wt.% with HHV of 35.3 MJ/kg, and oxygen content of 14.2 wt.%. The yields of biocrude increased up to 36.8 wt.% with addition of methanol, while the conversion decreased from 84.5 to 66.5% and energy recovery increased from 36 to 93%.

Presenter: **Yerrayya ATTADA, IIT MADRAS, CHEMICAL ENGINEERING, CHENNAI, INDIA**

Presenter's biography:

I AM A. YERRAYYA, I AM PURSUING Ph.D. IN IIT MADRAS, CHEMICAL ENGINEERING DEPARTMENT. I AM WORKING ON BIOFUELS AND CHEMICALS PRODUCTION FROM BIOMASS USING DIFFERENT THERMOCHEMICAL CONVERSION TECHNOLOGIES SUCH AS FAST PYROLYSIS, HYDROTHERMAL LIQUEFACTION AND MICROWAVE ASSISTED PYROLYSIS.

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Session reference: 3CV.6.12

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Techno-Economic Analysis of the Fast Hydrolysis of Woody Biomass in Sub- or Super-critical Water

Short introductive summary:

Hydrothermal liquefaction is potentially an economically viable thermochemical process for breaking down lignocellulosic biomass. This process breaks down a wide variety of organic materials, without requiring drying of the material prior to liquefaction or a catalyst, tailored to the structure of a particular organic material. An integrated process flowsheet was developed for the biomass pre-treatment, liquefaction and bio-oil separation. The mass and energy balances were modelled using gPROMS, incorporating the SAFT Mie equation of state, to determine the thermodynamic properties of water and its mixtures with organic compounds at elevated temperature and pressure. Preliminary sizing and costing of process equipment was carried out. Central to this work was the development of an integrated, detailed kinetic model of the fast hydrolysis of lignocellulosic biomass, based on a comprehensive survey of the literature. This fast reaction limits the formation of char by the repolymerisation of organic fragments, which is important, because compared with an analysis previously published, simultaneously increases the bio-oil product by 18% and reduces the capital cost of the plant by 38%.

Presenter: **Mario ALMEIDA CALADO, Imperial College, Chemical Engineering, LONDON, UNITED KINGDOM**

Presenter's biography:

Did Masters degree in Chemical Engineering at IST Lisbon, Portugal, at 2012.

Worked in advanced process modelling company PSE for 3 years in the Carbon Capture and Storage department.

Currently in my 3rd year of my PhD degree in Imperial College London on Hydrothermal Liquefaction of Biomass.

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Session reference: 3CV.6.14

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Can We Marry Pipeline Transportation with Hydrothermal Processing?

Short introductive summary:

World's environmental concerns over rise in ambient carbon levels have urged profound interest in mitigating atmospheric CO<sub>2</sub> levels by searching alternative routes of energy generation from renewable resources. In this regard, biomass-based biofuels have been regarded as a sustainable and clean substitute thanks to its availability and high energy potential. However, biomass delivery costs by trucks presents economic challenges as its cost of transportation is high. The pipeline transport of biomass slurry offers an alternative approach that allows operations at higher capacities and thereby providing benefits at higher economies of scale. The pipeline transported biomass slurry has high moisture content. Thus, integrating pipeline biomass transportation with hydrothermal processing has considerable economic benefits. The key hydrothermal processing technology such as 'hydrothermal liquefaction' has gained considerable attention which is capable of converting wet biomass into a higher heating value product.

Presenter: **Mayank KUMAR, University of Alberta, Edmonton, CANADA**

Presenter's biography:

Mayank is pursuing his studies in Energy and Environmental Systems Engineering at University of Alberta, Canada. His research is focused towards developing process models and performing techno-economic analysis of various bioenergy systems.

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Session reference: 3CV.6.16

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Hydrothermal Liquefaction in an Integrated Bio-Refining Platform

Short introductive summary:

In this presentation, the overall facilities in CBT with special focus to a large HTL pilot facility recently established with several novel technical developments will be discussed. The plant is a 135 m plug flow system with a constant inner diameter. It can operate at up to 300 bars and 425 °C. The flow rate can be up to 100 L/h and 20% dry matter content, depending on biomass type. A novel setup for pumping and oscillating the reactor contents as well as novel heat-recovery methods will be presented, allowing energy return on investment (EROI) values in excess of 10. In addition, new results from a range of biomasses, including willow, wheat straw and softwood will be presented.

Presenter: **Ib JOHANNSEN, Aarhus University, Engineering, Aarhus, DENMARK**

Presenter's biography:

Ib Johannsen

Associate Professor, Manager Center for Biorefinery Technologies

Project manager of several ongoing biorefining projects

+30 years experience from research and research management in industry and academia.

62 Peer reviewed articles in including Science, JACS, ..

17 Patents/patent app

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Session reference: 3CV.6.17

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS



## Hot Water Extraction for Protein and Amino Acids Recovery from Brewer's Spent Grains

Short introductive summary:

In the present study, hot water extraction was evaluated to recover protein and amino acids from BSG. Extraction experiments were performed under different conditions of temperature (30°C up to 170°C), solid-liquid ratio (1:15 up to 1:40), and heating time (1 up to 24 h) in order to verify the effect of these operational variables in the extraction yield and to select the conditions able to maximize the results.

Presenter: **Fen QIN, DTU, Novo Nordisk Foundation Center for Biosustainability, Kgs Lyngby, DENMARK**

Presenter's biography:

I am a postdoc researcher, currently working at Novo Nordisk Foundation Center for Biosustainability, DTU, Denmark.

My areas of expertise includes biomass pretreatment and hydrolysis, extraction of valuable chemical compounds from biomass.

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Session reference: 3CV.6.18

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Hydrothermal Co-Processing of Plastics and Biomass Waste Streams

Short introductive summary:

Plastic has become the material of the 21st century, reaching an annual world production of more than 300 million tons. A significant part of these plastics is leaching to the environment with growing concern. Some of the plastics, being it macro- or microplastics, are leached to the environment via biomass dominated waste streams such as household waste and municipal waste etc., but most of them are still incinerated. Primary recycling of plastics is ultimate, but is greatly challenged by strict material specifications – especially for technical plastics. The purpose of this work is to demonstrate that such technical plastics can be processed and recycled in mixed and co-processed with biomass to yield value-added chemicals, synthesis monomers, and fuel precursors.

Presenter: **Thomas Helmer PEDERSEN, Aalborg University, Energy Technology Dpt., Aalborg, DENMARK**

Presenter's biography:

Thomas Helmer Pedersen is a researcher and assistant professor at the Department of Energy Technology, Aalborg University, Denmark. His work focuses mainly on liquid fuels production from various feedstock through hydrothermal liquefaction.

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Session reference: 3CV.6.20

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

## Deactivation Pathways of Sulfonated Carbon Catalysts during Biomass Conversion Reactions under Hydrothermal Conditions

Short introductive summary:

The underlying deactivation pathways of sulfonated carbon catalysts were studied in aqueous phase biomass conversion reactions under continuous flow conditions. Furthermore the relation between structure and stability of sulfonic acid groups was studied through subjecting sulfonated carbon catalysts prepared from different carbons (pyrolysis of cellulose at 350-750 °C, activated carbon and graphite) to hydrothermal treatment. Deactivation is shown to be driven by the concerted effect of sulfonic acid group and proton leaching. A methodology for the synthesis of hydrothermally stable sulfonated carbon catalysts is presented. Proton leaching is shown to be a fully reversible mode of deactivation that can alternatively be suppressed through addition of cation complexation agents to the liquid feed.

Presenter: **David SCHOLZ, Paul Scherrer Institut, Bioenergy and Catalysis Laboratory, Villigen PSI, SWITZERLAND**

Presenter's biography:

David Scholz studied Chemical Engineering at ETH Zürich. Since august 2015 he is a PhD student in the catalytic process engineering group under the supervision of Prof. Dr. Frédéric Vogel. His research focuses on the development of catalysts for biomass conversion reactions.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 3CV.6.21

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Facile Synthesis of Mo/Al<sub>2</sub>O<sub>3</sub>-TiO<sub>2</sub> Catalysts using Spray Pyrolysis and Their Catalytic Activity for Hydrodeoxygenation**

Short introductive summary:

This work studied on the upgrading of the palmitic acid (hexadecanoic acid), which is the main component in the biocrude derived from hydrothermal liquefaction of microalgae. The spherical particles Mo/Al<sub>2</sub>O<sub>3</sub>-TiO<sub>2</sub> were firstly synthesized by combining sol-gel and spray pyrolysis method. The showed that the prepared catalysts exhibited the excellent catalytic performance of HDO of palmitic acid.

Presenter: **The Ky VO, Kyung Hee University, Chemical Engineering, Suwon, REPUBLIC OF KOREA**

Presenter's biography:

My name is Vo The Ky, a doctoral student at Chemical Engineering Department of Kyung Hee University, Republic of Korea

My research areas are biomass conversion, upgrading bio-oil, and catalysts.

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Session reference: 3CV.6.22

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## 1D Model for Investigation of Energy Consumption and Wear in Die Designs Used for Biomass Pelleting

Short introductive summary:

The study presents a 1D model for simulating the pelleting process in a die producing wood pellets. The model is capable of simulating the energy consumption in different press channel designs. The energy consumption is split into a friction and compression contribution, for examining the wall friction and pellet compression locally in the press channel.

In addition to the 1D model, the study concerns experimental single pelleting tests, used for validation of the model, and measurements of die wear from full scale production. The presented 1D model can lead to development of energy efficient die designs with improved durability.

Presenter: **Simon Klinge NIELSEN, Andritz Feed & Biofuel, Esbjerg, DENMARK**

Presenter's biography:

My name is Simon Klinge Nielsen. I am 26 years old and live in Esbjerg, Denmark.

I am an industrial PhD student at Andritz Feed & Biofuel. The study is done in co-operation with Aalborg University. In 2016 I graduated a Master degree in Process Engineering and Combustion Technology.

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Session reference: 2CO.13.1

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Prediction and Control of Biofuels Quality Using a Mathematical Modelling of Densification Process

Short introductive summary:

The paper deals with experimental research of the effect and interaction of technological variables and material parameters during densification and evaluation methodology for relevant experimental plan in order to determine the final biofuels quality and mathematical model. In this paper are presented research findings which are defining the impact and interaction of influencing variables at densification of selected Slovakian woods.

The main goal of this experiment was to obtain such results which can be used for mathematical models design.

Presenter: **Peter KRIŽAN, Slovak University of Technology in Bratislava, Faculty of Mechanical Engineering, Institute of Manufacturing Systems, Environmental Technology & Quality Management, BRATISLAVA, SLOVAK REPUBLIC**

Presenter's biography:

Academic degree(s): MSc.; PhD. and Assoc. Prof. on Faculty of Mechanical Engineering, STU in Bratislava.

Current position: Associate Professor on Faculty of Mechanical Engineering, STU in Bratislava; Head of Institute.

Research & development in field of biomass treatment and recovery.

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Session reference: 2CO.13.2

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Wet Granulation Method to Improve the Flowability of Cohesive Biomass Powders**

Short introductive summary:

Some biomass valorization processes, such as gasification in entrained flow reactors, require the use of powders. However, biomass powders present flow issues (arching in hoppers, ratholing...). The objective of this work is to develop a wet granulation method with biomass waste binders to improve the flow of cohesive biomass powders.

Presenter: **Clément VANNESTE-IBARCQ, CEA, Liten - Bioresources preparation laboratory, Grenoble Cedex 09, FRANCE**

Presenter's biography:

Clément Vanneste-Ibarcq is a 25 years old chemical engineer from France. He graduated from the French engineering school Ensiacet in Toulouse. He has a Master 2 "Process and Bioprocess Engineering". He is a third year PhD-Student and his research focuses on the flow of biomass powders in the context of biomass valorization processes. He is working in the French Alternative Energy and Atomic Energy Commission (CEA) in Grenoble, France.

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Session reference: 2CO.13.3

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Effect of Mechanical Stress from the Grinding Device on Biomass Powder Properties and on Energy Consumption**

Short introductive summary:

This work is based on the study of a model comparison of impact and attrition modes of dry milling process for the manufacture of ultrafine lignocellulosic biomass powders.

Presenter: **Karine RAJAONARIVONY, Montpellier, FRANCE**

Presenter's biography:

I am a Ph.D. student and I am on the end of my first year. I work at INRA Montpellier in the Agropolymers engineering and emergent technologies lines research. The topic of my theses is to produce powder from lignocellulosic biomass for an energetic application.

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Session reference: 2CO.13.4

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



## The Role of Inorganic Matter in Biomass Self-Ignition

Short introductive summary:

The increasing role of biomass in heat and power generation, but also in different sectors of industry makes it necessary to store, transport and process such materials in large quantities. Under conditions encountered e.g. in storages, but also in power plant mills, biomass is highly susceptible to self-ignition. Currently, no reliable models exist to explain this behavior. As ash forming elements are known to enhance thermal conversion processes via catalytic effects, we examine the role of such elements, especially potassium, in lab-scale and TGA-experiments for four different biomass materials. The results show that while K is seen to enhance pyrolysis, it only weakly affects heterogeneous oxidation, the decisive mechanism in self-heating/self-ignition. While the available literature emphasizes the importance of active metal elements, in this study their effect is found to be outweighed by other differences in the materials tested.

Presenter: **Lars SCHWARZER, Technical University of Denmark, Chemical and Biochemical Engineering Dpt., Kgs Lyngby, DENMARK**

Presenter's biography:

Lars Schwarzer is a PhD Student at Danmarks Tekniske Universitet since 12/2015, working on Biomass Particle Ignition in Power Plant Mills. He graduated from Karlsruhe Institute of Technology in 2012. Interests include combustion and other thermal/chemical conversion processes.

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Session reference: 2CO.13.5

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Bioenergy and the UN Sustainable Development Goals

Short introductive summary:

The 2030 Agenda for Sustainable Development Goals (SDGs) was adopted by the United Nations in 2015 and then ratified by 193 countries. The SDGs intend to steer society towards a more sustainable future, including action on climate change mitigation. Climate action as further mandated by the Paris agreement is expected to result in increased bioenergy use. However, impacts of bioenergy are not limited to climate change mitigation alone, but affect several other SDGs as well. Therefore, in this study we consistently and comprehensively assess how bioenergy affects the SDGs. This is done by using the integrated assessment model IMAGE to project bioenergy use in scenarios with and without climate change mitigation. The results indicate that synergies are strongest for SDG7 and SDG13, while trade-offs arise mainly for SDG15. The results are sensitive to the underlying assumptions on future socio-economic and technological developments, and whether climate change is mitigated or not. To maximize synergies and minimize trade-offs, bioenergy must be implemented within an internationally coordinated, agricultural and environmental policy framework

Presenter: **Birka WICKE, Utrecht University, Copernicus Institute of Sustainable Development, Utrecht, THE NETHERLANDS**

Presenter's biography:

Dr. Birka Wicke is an assistant professor at the Copernicus Institute of Sustainable Development at Utrecht University. Her bioenergy research focuses on integrated assessment and strategies for sustainable production of bioenergy feedstocks.

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Session reference: 4CO.14.1

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **The Effectiveness and Legitimacy of Novel Regional and Landscape-Based Approaches to Govern the Sustainability of Bioenergy and Biomaterials Supply Chains**

Short introductive summary:

Based on a quick-scan, the paper provides new insights on which regional and landscape-based approaches seem more legitimate and effective in measuring and documenting sustainability of bioenergy and biomaterials supply chains, and which ones are less legitimate and effective - also compared to traditional governance systems. The results will also provide insights to the key criteria and elements defining an effective and legitimate regional governance system.

Presenter: **Jinke VAN DAM, Jinke van Dam Consultancy, Bunnik, THE NETHERLANDS**

Presenter's biography:

Jinke van Dam has more than 15 years of international experience in the sustainability and governance of biomass value chains for different end-uses. The expertise of Jinke lies in analysing the impacts and possibilities of biomass production from agricultural and forestry land uses.

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Session reference: 4CO.14.2

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Gaps and Research Demand Analysis from Current Certification and Standardisation in a Sustainable Biobased Economy

Short introductive summary:

Sustainability certification has become an important tool for the growing biobased economy (bbe). The multi-actor research and innovation action project Star-ProBio is aiming to expand existing tools, methodologies and approaches for sustainability certification in the EU bbe. As a first step, a comprehensive assessment of existing labels, schemes and initiatives for sustainability certification as well relevant standards and standardisation activities on European, international and national levels has been conducted. Overall, we have analysed the criteria, indicators as well as the methodologies of more than 45 certification schemes, labels and initiatives, covering all relevant sectors of the bbe. In addition, a series of expert interviews has been conducted to identify gaps and potential demand for research in sustainability certification and standardisation. With this systematic analysis we identified a number of gaps, covering the following topics:

- Gaps & weaknesses in criteria & indicator sets
- Demand for harmonisation in criteria assessment and operationalisation
- Level playing field & consensus for minimum criteria in all BBE sectors
- Leakage effects from

Presenter: **Stefan MAJER, DBFZ-German Biomass Research Centre, Biofuels Dpt., LEIPZIG, GERMANY**

Presenter's biography:

Stefan Majer has joined the German Biomass Research Centre in 2007. His research interest focuses on the life cycle and sustainability assessment of current and future bioenergy options. In this context he is responsible for different LCA case studies and the development of approaches for the optim

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Session reference: 4CO.14.3

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Beyond Job Creation. Socio-Economic Assessment in the Bioeconomy**

Short introductive summary:

The potential on the use of biomass resources for the production of power, transport fuels and chemicals has become an important target in many countries looking for added economic value to the biomass. Bioeconomy not only looks at a more innovative and low-emissions economy but it also may contribute to reconcile the integration of natural resources such as land for food security and biomass for other industrial purposes. It is expected that in the next years, the transition from the current fossil-based to a future bio-based carbon economy will evolve creating an impact in all process industries. Ensuring a sustainable production of the biomass and its process will also contribute to socio-economic benefits that extend beyond the generation of jobs including rural development, working conditions, income among others. The paper presents the indicators analysis in Horizon 2020 funded projects and other projects funded by the International Energy Agency Bioenergy Task 40.

Presenter: **Rocio DIAZ-CHAVEZ, Stockholm Environment Institute - Africa Centre c/o World Agroforestry Centre (ICRAF), Centre for Environmental Policy, Nairobi, KENYA**

Presenter's biography:

Dr Diaz-Chavez is a Visiting Senior Research Fellow at the Centre for Environmental Policy of Imperial College London and Deputy Director of the Stockholm Environment Institute at the African Centre. Her main area of expertise is on sustainability assessment applied in bioeconomy and bioenergy.

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Session reference: 4CO.14.4

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Biomass Supply Chains Development in Rural Areas: How to Take Public Stakeholders' Needs and Expectations into Account?**

Short introductive summary:

The "Demonstrating Sites Network" project aims to contribute to developing biomass supply chains in rural areas and to promoting their territorial integration. To do so, project partners are building a consulting procedure which will allow them to guide industrialists willing to develop a bioeconomy project in Northern France and who are looking for biomass supply. The procedure purpose is to give references, tools, methods and feedbacks to the stakeholders interacting with the industrialist and to the industrialist himself. These elements should give them the possibility to organise a durable supply chain, to integrate the project into the territory and to answer to stakeholders' questions, fears or expectations. To collect the elements needed to build the procedure, three case studies have been followed. From these case studies, it has appeared that knowledge of public stakeholders' needs and expectations was incomplete to suggest information or ways which would guide them into territorial bioeconomy development. To fill this knowledge gap, a study has been led to identify public stakeholders' needs and expectations regarding bioeconomy development in their territories.

**Presenter: Lucile GODARD, Agro-Transfert Ressources et Territoires, Estrées-Mons, FRANCE**

Presenter's biography:

After obtaining my Engineer diploma at the National School of Agronomy in Bordeaux and a degree in territorial development, I studied management at the Sorbonne business school in Paris. Since 2015, I'm working on a project which aims to promote biomass supply chains development in rural areas.

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Session reference: 4CO.14.5

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Producing Advanced Fast Pyrolysis Bio-Oils by Ex-Situ Catalytic Vapour Reforming

Short introductive summary:

As part of the BioMates Project, funded within the Horizon2020 programme, the effect of different catalysts used in ex-situ catalytic fast pyrolysis of agricultural residues (straw) on product yield and quality is investigated. Beneath usual catalysts like zeolite HZSM-5 without and with Ni loading new types are tested, e.g. commercial activated carbon as well as activated carbon produced from pyrolysis fine char.

First results show a tendency also of the new catalysts towards the wanted direction (increased C/O-ratio, increased LHV and reduced water content in the organic phase. On the other side a severe decrease in yield and sugar content is noticed. So at least at the beginning the catalyst is too active and further process optimisation is necessary.

Presenter: **Tim SCHULZKE, Fraunhofer-Institut UMSICHT, Biorefinery and Biofuels Dpt., Oberhausen, GERMANY**

Presenter's biography:

I studied chemical engineering at University of Dortmund, where I received my diploma in 1992. From then on I work at Fraunhofer UMSICHT, since January 1st, 2013 as group manager Thermochemical Process and Hydrocarbons in department Biorefinery & Biofuels.

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Session reference: 3CO.15.1

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Hydrogen Assisted Catalytic Biomass Pyrolysis for Green Fuels

Short introductive summary:

Fast pyrolysis of biomass is a well-known technology for producing bio-oil, however in order to use the produced oil in modern engines the oxygen content must be decreased from 30 wt. % to 1 wt. %. This can be achieved by catalytic hydrodeoxygenation (HDO). Unfortunately deactivation due to coking of the catalyst is a common problem. The objective of the present work is to produce gasoline and diesel from beech. Fast pyrolysis in high-pressure hydrogen atmosphere in a fluid bed reactor with a commercial CoMoS/MgAl<sub>2</sub>O<sub>4</sub> catalyst as bed medium followed by an additional vapor phase HDO reactor has been used to obtain a liquid fuel with an oxygen content below 1 wt.%. GC-AED has been used to determine the oxygenates left in the oil and shows that only traces of phenol's, benzofuran's and naphthol's are left in the produced oil. The produced oil has an aromatic content up to 75 wt. %. The temperature and pressure has been varied in order to investigate its impact on the products. Oil yields up to 25 wt. % were obtained with an energy recovery of 58 %. An experiment without the HDO reactor shows that the oxygen is mainly removed the fluid bed reactor.

Presenter: **Magnus Zingler STUMMANN, Technical University of Denmark, Department of Chemical and Biochemical Engineering, Lyngby, DENMARK**

Presenter's biography:

I am currently a Ph.D. student working at DTU Chemical Engineering in Prof. Anker Degn Jensen's group, where I work with catalytic hydrolysis of biomass for oil production.

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Session reference: 3CO.15.2

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



**Insight into Catalytic In-Situ Co/Pyrolysis of Biomass Powder and Bio-Oil as Hydrogen Donor under Py-GC/MS**

Short introductive summary:

The pyrolysis of biomass have been extensively researched but optimum process conditions such as temperature, residence time and heating rate are still in doubt due to the complexity of woody biomass. For instance, the effects of temperature on product selectivity for different biomass has received less attention. Furthermore, hydrogen donor solvent in catalytic copyrolysis of biomass under low-pressure conditions has receive no attention. It is of interest to study the effects of hydrogen donor solvent with biomass pyrolysis vapors via catalytic means (zeolite upgrading) with an intent to suppress coke precursors from deactivating zeolite catalyst. Bio-oil has two fractions, aqueous and organic fraction. The aqueous fraction can undergoes carbon coupling or aqueous phase reforming. The heavy fraction of bio-oil (organic phase) has similarities to hydrogen donor solvent. Thus, might influence the hydrogen deficiency in zeolite upgrading of pyrolysis vapors, thereby reducing the coke yield. In this study, organic fraction from fast pyrolysis oil is used as hydrogen donor for catalytic co/pyrolysis of biomass powder.

Presenter: **ISAAC YEBOAH, NTNU, 7049, TRONDHEIM, NORWAY**

Presenter's biography:

I am a final year PhD student at Department of Chemical engineering, NTNU. I have been working on biomass conversion to fuel and chemicals via pyrolysis route. Herein, the focus has been catalyst development for cascade reaction of light oxygenates and hydrodeoxygenation of pyrolysis vapors.

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Session reference: 3CO.15.3

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Catalytic Co-Pyrolysis of Biomass and Plastics over Microporous and Mesoporous Catalysts Using a Tandem Micro Reactor-GC/MS**

Short introductive summary:

Michael Soll studied biology and received his PhD in 1993 at Ruhr University Bochum.

He has over 23 years of experience in business development, marketing and sales at various companies active in analytical instrumentation and analytical services in Europe. His functional experience includes marketing, application and sales of LC- and GC-coupled mass spectrometry, MALDI-TOF MS and chromatographic tools. End of 2014, he joined Frontier Lab, a global leading company in GC/MS coupled analytical pyrolysis. In his role, beside marketing of Frontier Lab products, he is supporting both users of pyrolysis and  $\mu$ Reactor products as well as distribution partners in whole Europe.

**Presenter: Michael SOLL, Frontier Laboratories Europe, Business Development, Essen, GERMANY**

Presenter's biography:

Dr. Michael Soll studied Biology at the Ruhr University of Bochum and has over 20 years' experience in sales and marketing of analytical solutions within Life Science & Chemical Analysis. He is consultant for Frontier Laboratories, a global leader in Analytical Pyrolysis.

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Session reference: 3CO.15.4

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Effect of Reforming Conditions in the Catalyst Deactivation in the Pyrolysis-Reforming of Biomass for Hydrogen Production

Short introductive summary:

This study deals with biomass pyrolysis and in-line reforming of pyrolysis volatiles, which last years has received increasing attention for sustainable H<sub>2</sub> production. Nevertheless, catalyst deactivation should be faced and therefore, in this work the effect of reforming conditions in the catalyst deactivation has been studied. The experiments have been performed with two in-line reactors, a conical spouted bed reactor for biomass pyrolysis and a fluidized bed reactor for the reforming of pyrolysis volatiles over a Ni reforming catalyst. The TPO analysis of the deactivated catalysts at different times on stream reveal two different types of coke: (i) coke I (amorphous), which encapsulates the Ni active sites and whose combustion is catalyzed at low temperatures, and; (ii) coke II (structured), which is burnt at higher temperatures and has a more structured nature.

**Presenter: Aitor ARREGI, University of the Basque Country, Chemical Engineering Dpt., Bilbao, SPAIN**

Presenter's biography:

Chemical Engineer. PhD Researcher in the Chemical Engineering Department of the University of the Basque Country. Research fields: pyrolysis and catalytic steam reforming of biomass and plastic waste.

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Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Can Biomass Yield Models Developed in East Germany Produce Reliable Estimations for Commercial Willow Plantations in Lithuania?**

Short introductive summary:

In recent years the area of short rotation willow plantations (SRWPs) increased rapidly in Lithuania due to the investments of international companies. Yet, lack of reliable non-destructive methods to estimate the potential yields hampers the further development of SRWPs industry in Lithuania. Thus the aim of this study was to compare biomass yields produced by first rotation, three year plantations in Lithuania and Germany and test if biomass prediction methods developed in Germany could produce reliable estimates in Lithuania.

Analyses of the yield data showed that SRWPs in Germany reach higher mean annual increments (measured in oven-dried biomass) than in Lithuania.

However, common allometric power equations based on German data as well as Yield appraisal models developed in Germany could be applied to Lithuanian SRWPs, particularly if very high accuracy is not the crucial point, for example in commercial SRWPs. However, minor systematic errors may occur and have to be taken into account.

**Presenter:** **Edgaras LINKEVICIUS, Aleksandras Stulginskis University, Faculty of Forestry and Ecology, Akademija, Kauno raj., LITHUANIA**

Presenter's biography:

2014 Doctor's degree achieved at Dresden University of Technology , in the field of forest growth and yield modelling.

Projects related to biomass production: 2016-2017 Biomass production and yield in Short rotation plantations in Lithuania. Project leader, main researcher.

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Session reference: ICO.16.1

Subtopic: 6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)

Topic: 6. INDUSTRY SESSIONS

## **Assessing the Potential of Forest Harvest Residues and Post-Consumer Wood for Material and Energy Use in Austria**

Short introductory summary:

The overall objective is to analyse the potential of forest harvest residues and post-consumer wood for material and energy utilisation in Austria in order to ensure a more sustainable and efficient supply of primary and secondary raw materials. An analysis of the impact of available potential of forest harvest residues (FHR) for further utilisation and currently under-utilised post-consumer wood (PCW) on the Austrian forest-based value chain was conducted by using secondary economic data, partly gathered in the COMET project Up2ndUse, in combination with the dynamic forest sector model FOHOW ("Forst- und Holzwirtschaft").

Presenter: **Martin BRAUN, University of Natural Resources and Life Sciences, Vienna, Marketing & Innovation, Vienna, AUSTRIA**

Presenter's biography:

Martin Braun is an expert in forest sector modelling. He received his doctorate in June 2017 at the Institute of Marketing and Innovation (BOKU) in which he investigated the carbon dynamics of the wood-based value chain. He is working as a post-doc at the Institute of Marketing & Innovation.

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Session reference: ICO.16.2

Subtopic: 6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)

Topic: 6. INDUSTRY SESSIONS

## Remote Sensing Systems for Estimating Wood Energy from Chestnut Orchards

Short introductive summary:

Precision forestry is gaining more and more attention within the monitoring of forests and the practical conduction of field operations. Remote sensing techniques with the scope to obtain information on large wooded areas can be conducted at different level of precision, according to the different type of goal to be achieved. The analysis of high resolution digital imagery and LiDAR, radio frequency and other remote sensing systems as UAV can provide information on quality data, yield and wood residues from forests.

Presenter: **Carla NATI, National Research Council, Ivalsa, Campi Bisenzio (FI), ITALY**

Presenter's biography:

Full degree in Forest Science, PhD in Wood Science, Researcher at CNR-Ivalsa since 2000.

Field of interest: Harvesting of SRF plantations, Recovery of agricultural wood residues,

Harvesting of traditional wood stands, Wood chipping and chips classification/characterization

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Session reference: ICO.16.3

Subtopic: 6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)

Topic: 6. INDUSTRY SESSIONS

## **Reducing Uncertainty on Water Content in Wood Chips by New Measurements Methods**

Short introductive summary:

The goal of the Danish funded ongoing research project (Real Moisture Content) is to achieve a significant improvement of the uncertainty of the determination of the water content in wood chips with online measurements and to identify and validate the foundation of a reference method. A method for improving the quality of the measurement of the water content in wood chips used for biomass boilers for district heating is thus developed.

Presenter: **Anne Mette FREY, Danish Technological Institute, Biomass and combustion technology, Aarhus, DENMARK**

Presenter's biography:

Ph.D. in Chemistry, Danish Technological University, Center of Sustainable and Green Chemistry, Design of Heterogeneous Catalysts, 2008

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Session reference: ICO.16.4

Subtopic: 6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)

Topic: 6. INDUSTRY SESSIONS

## **New Biomass Sampling Methodology for Optimizing the Combustion Process and Ensuring Stable Bioash Quality**

Short introductive summary:

A new methodology for sampling of bark and chips biomass and bioash has been introduced at two Norwegian sawmills. By introducing the new sampling methodology, the measurements will give a more accurate representation of the entire volumes of biomass and bioash. By using accurate raw material data an improved combustion process is achieved in order to ensure more efficient energy use, improved bio ash quality, lower emissions, lower energy consumption and lower maintenance costs at the biomass combustion plants.

Presenter: **Henning HORN, Treteknisk, Oslo, NORWAY**

Presenter's biography:

Education: MSc within thermal energy and combustion Technology. 12 years experience from the Wood industry. Main Fields of work is efficient utilisation of the Wood by-Products from the sawmills and enery efficiency of Production processes.

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Session reference: **ICO.16.5**

Subtopic: **6.1 Biomass Resources (Crops, SRF, Algae and Organic Waste)**

Topic: **6. INDUSTRY SESSIONS**



## Evaluation of Biomethane Production Potential from Various Organic Wastes and Kinetic Modeling Analysis

Short introductive summary:

In this study, various organic wastes typical of a livestock farm, a cattle slaughterhouse and agricultural waste streams were comprehensively investigated to determine the performance of each batch of waste during thermophilic anaerobic digestion (AD). To the best of our knowledge, this is the first report to study the utilization of wide range of organic substrates via AD microbes under thermophilic condition. The highest methane yield (110.83 mL CH<sub>4</sub>/g VSadded.day) was found in the AD of crushed animal carcasses on day 4. The performance results obtained were further utilized to analyze, compare and verify the utility of four proposed kinetic models, which are widely used in the scientific community. The Cone model was the best candidate to accurately estimate the biomethane yield, production rate of each substrate, and for calibration of the AD process parameters needed to achieve optimum operating conditions. The results demonstrated that the waste types studied exhibited high potential for biomethane production and biodegradability.

Presenter: **Soon Woong CHANG, Kyonggi University, Department of Environmental Energy & Engineering, Kyonggi, REPUBLIC OF KOREA**

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Session reference: 2CV.7.4

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Carbon Membranes for Biogas Upgrading: Techno-economic Feasibility Analysis

Short introductive summary:

Biomethane is a renewable energy produced from biogas upgraded to a level that can be injected into a gas grid and/or used as vehicle fuel. The most prevailing technologies in European region are water scrubbing, pressure swing adsorption and amine absorption. Although membrane technology has only about 4 % market today, this environmentally friendly and energy efficient technology has a great potential for biogas upgrading if a high performance and low cost membrane is used for the upgrading. Today there is, however, no high performance membrane on the market for this application. In this work, we reported high performance hollow fiber carbon membranes that can exceed CO<sub>2</sub>/CH<sub>4</sub> Robeson upper bound (CO<sub>2</sub>/CH<sub>4</sub> selectivity 100) from cheap cellulosic materials for biogas upgrading. In order to document the techno-economic feasibility, the HYSYS simulation together with cost estimation was conducted.

Presenter: **Xuezhong HE, Norwegian University of Science and Technology, Department of Chemical Engineering, Trondheim, NORWAY**

Presenter's biography:

I have more than 10years' experience in membrane science and engineering, with solid knowledge and high competence gas separation /purification, specialized in biogas upgrading and biohydrogen upgrading

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 2CV.7.10

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## The Role of Biogas in the Italian Energy's Scenario: the Case of "Tempio" Farm

Short introductive summary:

The purpose of this paper is to analyze the contribute of Italian biogas sector on the way towards a bio-based production paradigm, pinpointing outcomes and trends in co-processing implementation. Therefore, assessing the suitability of the route taken by the leading manufacturers of bioenergy towards bio-economy programs is fundamental, in order to evaluate opportunities and barriers as regards the use of biogas as alternative raw materials and fuels, to improve resource efficiency and environmental performance, in the wider perspective of a bio-based economy.

Therefore, the paper starts with a synthesis of elements relating to the energy scenario at European and national levels, with particular reference to the evolution of Renewable Energy Sources (RES) and biogas, regulations, and strategies. Subsequently, we conducted an in-depth analysis of the technical and economic aspects associated with the major methods of biogas production, together with an assessment of the Italian scenario. In this part the Italian "Tempio" farm is presented. This in order to evaluate the contribution that the organization can offer to building sustainability in its three dimension.

Presenter: **Daniela SICA, University of Salerno, Department of Management & Innovation Systems, Fisciano (SA), ITALY**

Presenter's biography:

Research Fellow in Commodity Science - Faculty of Economics, University of Salerno. Currently Lecturer in Technology and Sustainability (Bachelor's Degree in Economics and Management) University of Salerno – Italy. She participates to numerous national and international congress.

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Session reference: 2CV.7.11

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Hydrogen and Methane Production from Two-Phase Thermophilic Anaerobic Codigestion of Waste Activated Sludge and Organic Fraction of Municipal Solid Waste**

Short introductive summary:

The integration of wastewater and organic waste treatment has many potentialities: the treatment of two organic substrates in the same plant allows to take advantage of the synergies which develop in a codigestion system and at the same time to supply a precious support in the wastewater treatment. In this study, the organic substrates treated are waste activated sludge (WAS) and the organic fraction of the municipal solid waste (OFMSW).

Presenter: **Giulia MORETTO, University Ca' Foscari Venice, Environmental Sciences, Mestre, ITALY**

Presenter's biography:

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Session reference: 2CV.7.13

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Hydrogen and Methane Production by Codigestion of Organic Solid Waste and Waste Activated Sludge in a Discontinuous Process

Short introductive summary:

The codigestion of different organic waste has been proposed to increase the hydrogen (H<sub>2</sub>) and methane (CH<sub>4</sub>) production rate in fermentation and methanogenic processes. The objective of this work was to evaluate the productivity of hydrogen in a dark fermentation process and methane in methanogenic process by a codigestion of waste activated sludge (purged sludge, PS) and organic solid waste of a restaurant (OSW). Different combinations of the residues were tested in batch experiments. The results showed that the maximal methane production was obtained using OSW without a codigestion. For the PS, the methane production increase as result of the OSW addition. The proportion of mixture formed by 90% of food residues and 10% of purge sludge, obtained the highest accumulated H<sub>2</sub> production and volatile solids removal. Carbohydrates removal was higher than 88% independently of the mixture evaluated. In all cases the main volatile fatty acids was acetate. The results showed a feasibility to use codigestion of PS and OSW to increase the gas-biofuels (H<sub>2</sub> and CH<sub>4</sub>) production.

Presenter: **Ivan MORENO-ANDRADE, Universidad Nacional Autonoma de Mexico, Instituto de ingenieria, Querétaro, MEXICO**

Presenter's biography:

Dr. Moreno Andrade received his Ph.D. in Biological Sciences from UNAM in 2006 and was a postdoctoral fellow at UC-Berkeley USA (2007-2008). He is a full time research scientist at the Institute of Engineering of the UNAM in Queretaro, Mexico since 2008.

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Session reference: 2CV.7.14

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Increased Gasproduction and Reduction of GHG Emissions by Up-Front Reduction and Recovery of Methane**

Short introductive summary:

In the present study the losses of methane in stables prior to collection have been estimated and the losses in pre-tanks before the biomass reach the anaerobic digester at 3 biogas plants has been measured over longer periods. Finally the methane production from cattle and pig manure in pre-tanks has been demonstrated at controlled temperatures and the impact of addition of highly degradable wastes has been assessed.

Presenter: **Henrik MØLLER, Aarhus University, Engineering, Tjele, DENMARK**

Presenter's biography:

Henrik B. Møller is senior researcher at department of Engineering (AU-ENG) and has 25 years experience with research and development of the biogas technology. His research area covers most aspects of biogas including pre-treatment, process optimisation and environmental aspects.

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Session reference: 2CV.7.18

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## CO<sub>2</sub> Partial Pressure in the Reactor Slurry and its Relationship to Methane Production

Short introductive summary:

Methane production during anaerobic digestion requires CO<sub>2</sub> and H<sub>2</sub> for the hydrogenotrophic methanogenesis. Dynamics of CO<sub>2</sub> partial pressure (pCO<sub>2</sub>) in the biogas slurry was recorded in several approaches in batch as well as in continuous anaerobic fermentations. In the first part of the approach, pCO<sub>2</sub> was measured in batch fermentations with increasing organic loading. At the beginning of the batch fermentation at high pCO<sub>2</sub> levels, methane production rate was low. The methane production rate increased sharply when pCO<sub>2</sub> started to decline while maximum methane production peaked around pCO<sub>2</sub> of 50 hPa. Comparison of theoretical CO<sub>2</sub> saturation according to Henderson-Hasselbalch equation with the measured values indicated that the slurry was CO<sub>2</sub> oversaturated for the most time. Thus, high CO<sub>2</sub> levels could not be used effectively in hydrogenotrophic methanogenesis. In follow-up continuous anaerobic fermentations, pCO<sub>2</sub> in the slurry reacted very sensitively substrate additions and indicated also process instabilities. Assessment of pCO<sub>2</sub> in the biogas slurry can be combined with other processes parameters to a holistic view on the anaerobic fermentation process.

Presenter: **Kerstin MAURUS, Ulm University, Institute for Systematic Botany and Ecology, Ulm, GERMANY**

Presenter's biography:

phD student at Ulm University (Germany), working on: on demand biogas production using sugar beet silage as a fast degradable substrate

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Session reference: 2CV.7.19

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

**Modified Gompertz Kinetic Study of Methane Production from Anaerobic Digestion of Recycled Sludge Paper Mill**

Short introductive summary:

The industry of the recycled paper is a growth activity in the world, which consumes a significant amount of resources in terms of raw materials and energy. The treatment of recycled paper wastewater remains a challenge and an environmental barrier. Among different techniques of treatment; the anaerobic digestion has been revealed as an effective and promising method for wastewater from the recycled paper industry [1, 2].

The kinetic model of methane production by anaerobic digestion is a practical way to understand the ultimate methane production in an economical short time. Several kinetic studies reported at literature, show the effectiveness of models application on anaerobic digestion process, using a different kind of reactors and substrates. The kinetic model equations could be used to predict dynamic simulation of the anaerobic digestion on the basis of a complex matrix with kinetic constants for different degradation steps of organic matter in completely stirred tank reactors (CSTR) [3]. Kun Li and al (2015) reported that the Cone model fitting the experimental data and the calculated parameters give a longer lag phase and lower hydrolysis rate at higher load

Presenter: **Mohammed BAKRAOUI, Ibn Tofail University faculty of science and Research Institute In Solar Energy And New Energy, physical, Kenitra, MOROCCO**

Presenter's biography:

I'm Mohammed BAKRAOUI a Phd student in 3 rd year in Ibn Tofail University of Science in Kenitra Morocco, I'm working on Anaerobic Digestion at Biomass and Renewable Energy Laboratory.

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Session reference: 2CV.7.20

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



## Effect Of Furfural On Methane Production From Of Hydrothermally Pre-Treated Bagasse

Short introductive summary:

Biomethane potential tests were performed using different furfural concentration to assess the impact of furan inhibitors generated during the lignocellulosic biomass pre-treatment. The results showed that the anaerobic digestion process was not inhibited when the furfural concentration was 1000mg/L. On the contrary, an increase in methane production was observed because of the furfural degradation. The best methane potential was obtained with the leaching of hydrothermal pre-treated sugarcane bagasse.

Presenter: **Martín Darío HERNANDEZ, Instituto de Ingenieria UNAM, LIPATA, Querétaro, MEXICO**

Presenter's biography:

Master student in engineering with the intention to generate and obtain knowledge in the field of bioenergy and recovery of waste.

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Session reference: 2CV.7.24

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Direct Methanation of Biogas by Fluidised Bed: Long-Duration Demonstration

Short introductive summary:

A new Power-to-Gas technology was validated for biogas upgrading without prior CO<sub>2</sub> separation in collaboration between PSI and Energie360°. The system was demonstrated under real conditions during a long-duration test (1100 h) using fluidised bed methanation. The experimental results of fluidised bed methanation and gas cleaning can be scaled up from the COSYMA scale to that of an industrial plant of 200 m<sup>3</sup> biogas per hour. A potential analysis focusing on existing wastewater treatment plants and on industrial green waste biogas plants showed that the largest potential of units in Switzerland are plants with an average size of 200 m<sup>3</sup>/h of biogas (11 GWh/a).

Presenter: **Serge BIOLLAZ, PSI - Paul Scherrer Institut, Thermal Processes & Combustion, Villigen PSI, SWITZERLAND**

Presenter's biography:

Education: Master and PhD from ETH Zürich as Mechanical Engineer

Actual Position: Head of a research group at PSI

Research interest: Biomass gasification and Biogas for electricity and biomethane generation

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Session reference: 2CV.7.25

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## In-Situ Biogas Upgrading: Contribution of Homoacetogenesis to Methane Production.

Short introductive summary:

In in-situ biogas upgrading, addition of H<sub>2</sub> to anaerobic digestors induces hydrogenotrophic methanogenesis (HM), however it can also stimulate homoacetogenesis (HA) which results in conversion of acetate instead. To assess the contributions of these microbial communities in sludge adapted and non-adapted to H<sub>2</sub> injections, labelled acetate (<sup>13</sup>CH<sub>3</sub><sup>12</sup>COOH) was used to trace the conversions pathways, providing evidences of inhibitions and HA contribution. The acetate isotope analysis showed acetate consumption was inhibited at high hydrogen partial pressure, which can be either indication of acetoclastic methanogenesis and syntrophic acetate oxidation inhibition, substrate preference to HM pathway, or both. The mass balance calculated results in a HM contribution of 80±7%, 69±3% and 94±0.1% in the non-adapted sludge, adapted 1 and adapted 2 respectively. Moreover, the results showed that inhibitions mechanisms and microbial adaption to hydrogen plays an important role in the biomethanization process and they should be considered to achieve a higher methane fraction in the biogas without reactor failing.

Presenter: **Nathalia DOS REIS VECHI, Aarhus University, Department of engineering, Aarhus, DENMARK**

Presenter's biography:

I have a Bachelor in Chemical engineering from University of Southern Santa Catarina-Brazil, and I am currently doing a master degree in Biotechnology and Chemical Engineering(Environmental technology) at Aarhus university-Denmark.

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Session reference: 2CV.7.26

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Assessing Sweet Sorghum-based Ethanol Potential under Water-Energy-Food Nexus Framework

Short introductive summary:

(1) As water, energy and food are the most fundamental natural resources for human sustainable development, this study presented an integrated method for assessing sweet sorghum-based ethanol potential with the consideration of Water-Energy-Food nexus principles.

(2) The method has been validated in Dongying City, Shandong Province, China, which is a coastal city on the banks of the Yellow River Delta.

(3) This study indicated that the area of saline-alkali land in Dongying City was 4261 km<sup>2</sup> with the percentage of 54%, whereas over 30% of the saline-alkali land in Dongying was not suitable for sweet sorghum development under WEF nexus, and the GHG emissions were about 0.6 million tons per year.

Presenter: **Xiaoxi YAN, INSTITUTE OF GEOGRAPHIC SCIENCES AND NATURAL RESOURCES RESEARCH, Chinese Academy of Sciences, Beijing, P.R. CHINA**

Presenter's biography:

My name is Xiaoxi Yan. I am currently working on my master project in the the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences. I have been studying the assessment of non-food based ethanol potential.

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Session reference: 1CV.8.1

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

## Terrestrial Laser Scanning in Volume and Biomass Modelling - Overview

Short introductive summary:

Growing stock volume and biomass are among the most important attributes for forest-related decision making, from private owners of small forest holdings to global level policy makers. The reliability of estimates of those attributes depends essentially on the availability of existing allometric models which vary immensely through countries and tree species. Therefore, the purpose of the work is to evaluate and review the current state-of-the-art of terrestrial laser scanning (TLS) techniques and its potential and challenges in volume and biomass modelling. In addition, the objective is to identify the key factors affecting the capabilities of TLS data in model development and calibration.

Presenter: **Ville KANKARE, University of Helsinki, Department of Forest Sciences, Helsinki, FINLAND**

Presenter's biography:

Ville Kankare. He received the D.Sc (Agriculture and Forestry) degree in August 2015 from the Department of Forest sciences at the University of Helsinki, Finland. Current research interests include the use of remote sensing, especially laser scanning, based methods in precision forestry.

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Session reference: 1CV.8.4

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

## **Optabium Method: Building and Assessing Sustainable Agricultural Biomass Supplies**

Short introductive summary:

The objective of the OPTABIOM method is to answer the questions about biomass supply chains and help to establish the development of non-food valuation schemes by linking them to local production of quality biomass, in order to preserve or even create added value in the territory. This method leads to propose and evaluate supply chains of agricultural biomass, taking into account the local specificities (natural environment), the farm specificities, the biomass sector of the territory and the value-added site (process, needs and expectations). This method is divided in several steps that present in this paper

Presenter: **Hélène PREUDHOMME, Agro-Transfert, Estrées Mons, FRANCE**

Presenter's biography:

I started my career with a thesis on the genetic determinants of biomass production in miscanthus. Then I worked for several years in the field of applied research on potato cultivation.

I work today for the development of biomass sectors in Hauts de France

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Session reference: 1CV.8.5

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

## **Electric Power from Agricultural Residual Biomass (Arb), in Colombia. Option of Rural Development after the Civil War.**

Short introductive summary:

In Colombia existing agriculture generates just over 53.5 million ton of agricultural residual biomass annually (ARB) with a theoretical electrical potential of 59 895 GWh year<sup>-1</sup>, which represents 90% of the energy generated in 2015. However, this potential is not being used even though Colombia has non-interconnected areas, equivalent to 52% of the national territory. On the other hand, it is not possible to use the entire ARB, since it requires a certain amount to provide nutrients to the soils, so that only between 27 800 and 41 700 GWh year<sup>-1</sup>, depending on the conversion technology selected, representing 41.8% and 62.7% of the energy consumed annually.

**Presenter: German LOPEZ, Universidad Distrital Francisco José de Caldas, Bogotá, COLOMBIA**

Presenter's biography:

Mechanical Engineering; Magister in Mechanical Engineering. PhD student Universidad Distrital Francisco José de Caldas. Colombia.

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Session reference: 1CV.8.8

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

## Current Status and Prospects for Biofuel Production in Poland

Short introductory summary:

The main substrates for producing biofuels in Poland are rape and corn. Rape is used for producing esters which can be directly used for running an engine or can be mixed with diesel. Corn is used for producing bioethanol which is mixed with gasoline. 1.24 mln tons of ester and 205,444 tons of bioethanol were produced in 2016 in Poland. New technologies are implemented for biocomponent production in Poland. Among these is the promising technology co-hydrogenation.

Presenter: **Krystian BUTLEWSKI, Institute of Technology and Life Sciences, Biomass Processing Technologies Dpt., Poznan, POLAND**

Presenter's biography:

Krystian Butlewski is the Polish scientists specialized in utilization of biomass and organic wastes into energy and biofuels. His main interest is to develop the most effective way for converting biomass into energy and energy carriers. He is representative of Poland in IEA Bioenergy.

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Session reference: 1CV.8.9

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES



## **Assessment of European Union's Agricultural Residue Potentials Available for High-Added Value Products: Current State and Future Development**

Short introductive summary:

Lignocellulose from agricultural residues are a promising feedstock for a sustainable bioeconomy. Research in the field of green chemistry is increasingly concentrating on developing valorisation processes of such residues. To successfully implement a material use of lignocellulose on industrial scale, one have to answer questions about feedstock availability first: What feedstock shows the highest potentials? Where is the feedstock distributed? How does the feedstock supply develop in the future?

Presenter: **Lars WIETSCHEL, University of Augsburg, Augsburg, GERMANY**

Presenter's biography:

PhD student at the University of Augsburg at the chair for Production & Supply Chain Management

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Session reference: 1CV.8.10

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

## **Modelling-Based Procedure to Evaluate Energy Crops Productivity in Marginal Humid Areas of Low Po Valley (Northern Italy)**

Short introductive summary:

The expected shortage of conventional energy sources and Global Renewable Energy Policies solicit innovative strategies to meet the energy supply demand while reducing environmental and health hazard due to fossil fuels dependency. In this context, biomasses from non-food energy crops are perceived as promising renewable resource for the production of bioenergy, especially in marginal humid areas (MHAs). In this context giant reed (*Arundo donax* L.) provided encouraging results in Northern Italy, due to the favorable relationship between productivity levels, environmental sustainability and inputs/cost needed to achieve them. Nevertheless, the response of this crop under future climate is still an open issue, despite the crucial implications for mid-term planning policies. Biophysical models are used to address these questions, due to their capability in reproducing interactions between plant, weather, soil and agricultural practices, via spatially explicit simulations. The use of component-oriented programming allows to compose customized, reusable and extensible modelling solutions, by linking set of software components for specific sub-domains of the system (crop, soil water,...).

**Presenter:** **Enrico CEOTTO, CREA- Council for Agricultural Research and Economics, Research Centre for Agriculture and Environment, Bologna, ITALY**

Presenter's biography:

Enrico Ceotto is Senior Researcher Agronomist at the Research Center Agriculture and Environment, located in Bologna, Northern Italy. Currently, his research activity is focused on perennial energy crops and their ecosystem services. E-mail address: [enrico.ceotto@crea.gov.it](mailto:enrico.ceotto@crea.gov.it).

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Session reference: 1CV.8.13

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

## **Biomass Energy Potential and Technological Options for Livestock Manure Management in Extensive Production Systems in Mexico**

Short introductive summary:

A biomass energy potential assessment was performed through an adapted methodology to quantify the livestock biomass potential, according to livestock production systems, zootechnical functions and technical factors, in southeast Mexico. Moreover, a weighted decision matrix (WDM) was designed to determine the most feasible technologies employing sustainability criteria in order to provide useful data for the livestock residue management in extensive production systems

Presenter: **Oscar SILVÁN HERNÁNDEZ, UJAT, DACBIOL, Villahermosa, MEXICO**

Presenter's biography:

Researcher at DACBIOL-UJAT (Universidad Juárez Autónoma de Tabasco) and UAG (Universidad Autónoma de Guadalajara) in Villahermosa, México. He holds a Master's degree in Project Management and Energy Efficiency.

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Session reference: 1CV.8.16

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

## Fostering Sustainable Feedstock Production for Advanced Biofuels on Underutilised Land in Europe

Short introductive summary:

FORBIO introduces a methodology which holistically captures the main aspects of relevance when performing a pre-feasibility assessment of perspective advanced biofuel value chains on underutilized and contaminated sites in Europe (and neighbouring countries). At the 26th EUBCE the focus of the presentation will be on the main achievements and results of the FORBIO project. This will include the results from feasibility studies in three selected case study locations: Germany (lignite mining and sewage irrigation fields in the metropolis region of Berlin and Brandenburg), Italy (contaminated land from industrial activities in Sulcis, Portoscuso) and Ukraine (underutilised marginal agricultural land in the South of Kiev). The biomass production potential and its related costs will be presented and discussed. In addition the preliminary findings from the sustainability assessment of the value chains tested will be presented. Perceived economic and non-economic barriers to the uptake of these value chains will also be discussed.

Presenter: **Marco COLANGELI, GBEP - FAO, Climate and Environment Dpt., Rome, ITALY**

Presenter's biography:

Mr. Colangeli works as a Bioenergy Expert in FAO since 2011. He holds a BSc in Forestry and Environmental Science, a MSc in Environmental Science for Large Urban Areas from Università degli Studi della Tuscia, and a MSc in Environmental Science and Policy from PACE University of New York.

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Session reference: 1CV.8.19

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

## **The Intense Project: Intensify Production, Transform Biomass to Energy and Novel Goods and Protect Soils in Europe**

Short introductive summary:

INTENSE is a transnational research project funded in the frame of the ERA-NET Cofund FACCE SURPLUS (Sustainable and Resilient agriculture for food and non-food systems), which is formed in collaboration between the European Commission and a partnership of 15 countries in the frame of the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI). FACCE SURPLUS is committed to improve collaboration across the European Research Area in the range of diverse, but integrated, food and non-food biomass production and transformation systems, including biorefining.\*

As such, INTENSE responds to three "Great Challenges" of the 21st century, global food security, use of renewable raw materials and production of energy from biomass, for which the agricultural sector is important. INTENSE contributes to sustainably increasing food production, producing novel products from agriculture and developing new perspectives for European rural landscapes.

Presenter: **Peter SCHRÖDER, Helmholtz Zentrum München GmbH, Comparative Microbiome Analysis, Neuherberg, GERMANY**

Presenter's biography:

Peter Schröder is deputy director of the Research Unit Comparative Microbiome Analysis at HMGU, and leads the working group Plant Microbiome. He was co-ordinator and sub-co-ordinator of several international projects on agricultural practise and is affiliated to Technical University of Munich.

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Session reference: 1CV.8.22

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

## Quantifying the Residual Biogas Potential from Livestock Waste in England

Short introductive summary:

The Anaerobic Digestion (AD) industry has expanded significantly in the last ten years in the UK since the introduction of financial mechanisms for the production of renewable energy, which has given rise to the increase in hectares of arable land allocated to energy crops. Despite the fact that manures and slurries are the most abundant substrates, their uptake in AD systems is still poor.

This research aims to develop a GIS based tool to quantify the residual biogas potential stemming from livestock waste, i.e. manures and slurries, in England. The analysis first looks at the supply side by estimating the annual production of manures and slurries starting from the public dataset of the agricultural survey published by Defra. This quantity is then compared with the annual demand of livestock waste arising from operational biogas plants in England. Results are discussed and put into the context of current energy policies.

Presenter: **Mariano MARINARI, University of Bath, Chemical Engineering, Bath, UNITED KINGDOM**

Presenter's biography:

After graduating in 2007 in Environmental Engineering, I worked for four years in the solar energy industry in Italy in different organisations taking on various roles from designing to project management. I am now at the University of Bath as PhD candidate working on rural biogas installations.

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Session reference: 1CV.8.23

Subtopic: 1.1 Biomass potentials and biomass mobilisation

Topic: 1. BIOMASS RESOURCES

## Technical-Economic Evaluation of a Small Liquefaction Plant for Bio-LNG Production

Short introductive summary:

In this paper, a technical-economic evaluation of a small bio-LNG production plant (10t/day of raw biogas processed) has been conducted. The basic plant configuration consists on a two-pressure levels Joule-Brayton reverse cycle, with nitrogen as working fluid. Liquefaction of bio-methane occurred after the upgrading with conventional processes. The system has been simulated and optimized in ASPEN HYSYS, determining the values of the various working parameters which minimized the energy specific consumption. First results showed that a bio-LNG plant requires between 0.57 and 0.72 kWh/Nm<sup>3</sup> without considering additions for heating and raw biogas pre-treatment. After that, an economic analysis of the entire plant has been conducted, also comparing the upgrading processes actually available on the market. This analysis showed that the efficiency of the cryogenic expander is the most critical component of the plant, both from the economic and technical point of view.

Presenter: **Stefano FRIGO, University of Pisa, Energy, Systems, Territory and Costruction Engineering Dpt., Pisa, ITALY**

Presenter's biography:

Stefano Frigo took a Bachelor in Mechanical Engineering in 1991 and a Ph.D. in Energetic at the University of Genoa in 1994. From 1998 he works at the University of Pisa carrying on research activities concerning internal combustion engines and biomass utilization in cogeneration power plants.

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Session reference: 2DO.1.1

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Technologies for Biomethane Production in Small and Medium Scale Applications - Assessment within the European Project RECORD BIOMAP

Short introductive summary:

The European Horizon 2020 project Record Biomap builds up a knowledge transfer platform aiming to foster technology solutions for a cost efficient biomethane production at small to medium scale.

Within the framework of the project technology descriptions of at least 30 technologies, which are still in their development phase (Technology Readiness Level 3 to 7), are collected, presented on the biomethane map (<https://biomethane-map.eu>) and assessed through an impact assessment.

The presentation will give an overview of the project's focus and results, concentrating on the results of the impact assessment for innovative technology solutions along the biomethane supply chain and especially upgrading of biogas to biomethane. The assessment includes aspects such as energy efficiency, flexibility and robustness of the systems, economic parameters and the contribution to the reduction of greenhouse gas emissions. The results in the form of a comparative presentation of parameters are expected to highlight the special application areas of the technologies. In addition, a roadmap for the market implementation of innovative small scale upgrading technologies will be presented.

Presenter: **Kathrin BIENERT, DBFZ Deutsches Biomasseforschungszentrum gGmbH, LEIPZIG, GERMANY**

Presenter's biography:

Kathrin Bienert is a scientist at DBFZ Deutsches Biomasseforschungszentrum gGmbH in Leipzig since 2010. Before joining the DBFZ, she worked in the industrial sector as project developer for a German technology company specialized in biomass gasification technologies.

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Session reference: 2DO.1.2

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



## **Investigating the Economics of Small Scale Domestic Anaerobic Digestion Systems**

Short introductive summary:

The aim of this work is to investigate the minimum scale at which urban AD systems start becoming financially viable and explore the possibility of moving treatment closer to source. Therefore, an economic tool built in a spreadsheet was created to study the economics of small scale AD systems treating domestic waste. The targeted feedstocks were food waste, source separated waste (black water) and sewage. The tool was integrated with a steady-state process model of AD, in which the methane production is calculated, based on the feedstock type, reactor design and operational conditions. The integrated model was then used to evaluate different scenarios and study the impact of several factors on the economic viability of small scale AD systems

Presenter: **Ioannis MARKIDIS, Bath, UNITED KINGDOM**

Presenter's biography:

I am a PhD student looking into small scale decentralised anaerobic digestion modelling.

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Session reference: 2DO.1.3

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Model-Based and Experimental Analysis of Small Scaled Biogas Upgrading via Water Scrubbing

Short introductive summary:

Within the present study, the conception of a water scrubbing based Biogas upgrading system for low production rates and reduced CO<sub>2</sub>-separation is performed. The generated concepts are based on a comprehensive modelling of the different gas treatment steps. A validation of the simulation results regarding the methane enrichment process design is performed via laboratory scaled ex-perimental studies.

Presenter: **Wilfried ZÖRNER, Technische Hochschule Ingolstadt, Institute of new Energy-Systems, Ingolstadt, GERMANY**

Presenter's biography:

Sine 1998: Professor for design and development at Technische Hochschule Ingolstadt / Academic head of the Institute of new Energy Systems

1991-1998: Various R&D- and executive positions in industry

1988-1991: Ph.D. at Technical University of Munich on small-scale solar-thermal power generation

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Session reference: 2DO.1.4

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Desulfurization of Biogas from Varied Sources for Sensitive Energy Converters

Short introductive summary:

Biogas cleaning requirements vary based on biogas source and on the tolerance of the downstream converter. Fuel cells and catalytic methanation reactors are sensitive to several impurities in biogas, especially sulfur compounds, to a greater degree than “traditional” downstream processes such as engines, and therefore require stricter gas cleaning processes. Two related projects are presented. An adsorption-based biogas cleaning system for deep desulfurization (0.5 ppmS) was validated during a long-duration field test (1100 h). A successful combination of sorbent materials protected the catalytic methanation reactor during direct methanation of biogas. Then, parallels are drawn to a next project on desulfurization of manure biogas for an SOFC, including lab tests performed to prepare for a field demonstration.

Presenter: **Serge BIOLLAZ, PSI - Paul Scherrer Institut, Thermal Processes & Combustion, Villigen PSI, SWITZERLAND**

Presenter's biography:

Education: Master and PhD from ETH Zürich as Mechanical Engineer

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Session reference: 2DO.1.5

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **The Consistency of Carbon Budgets of Forest Bioenergy Systems with the UK's Cumulative Emission Budget**

Short introductive summary:

This work presents the evaluation of the temporal profiles of greenhouse gas balances associated with different forest-based bioenergy systems alongside the relevant national and international accounting frameworks. While most environmental assessments of bioenergy supply chains consider the reduction potential of bioenergy compared to another fuel source, the aim of this work is to quantify the actual carbon emissions associated with forest-based bioenergy and its share within relevant mission budgets.

Presenter: **Mirjam ROEDER, University of Manchester, Manchester, UNITED KINGDOM**

Presenter's biography:

Mirjam Röder is a Research Fellow with the Supergen Bioenergy Hub at the Tyndall Centre for Climate Change Research at The University of Manchester. Her research interests focus on climate change, bioenergy and related sustainability aspects.

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Session reference: 4DO.2.1

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Quantifying the Climate Impact of Bioenergy Production Systems Over Time

Short introductive summary:

This study introduces an assessment framework to quantify the climate mitigation potential of bioenergy systems over time. The framework uses a dynamic life-cycle inventory (i.e. also including carbon stock changes and counterfactual emissions) and proposes a new system performance metric, the Relative Climate Impact (RCI). The RCI quantifies the climate impact of bioenergy systems over time and offers the flexibility to alter the climate impact (e.g. radiative forcing, temperature change), equivalency metric (e.g. global warming potential, global temperature potential), and time horizon. As such, it helps LCA practitioners to better quantify and compare the climate mitigation potential of bioenergy systems over time.

Presenter: **Sierk DE JONG, Utrecht University, Copernicus Institute of Sustainable Development, Utrecht, THE NETHERLANDS**

Presenter's biography:

Sierk de Jong is a PhD candidate at the Copernicus Institute (Utrecht University) where he focuses on the economic and environmental performance of renewable jet fuel conversion pathways.

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Session reference: 4DO.2.2

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Capture and Removal of CO<sub>2</sub> from the US Ethanol Industry

Short introductive summary:

Great Plains Institute, Kansas Geological Society, and Improved Hydrocarbon Recovery, LLC are researching the feasibility of capturing and storing or utilizing biogenic CO<sub>2</sub> from the corn ethanol industry. This approach could offer value for ethanol producers by offering value for a waste product and lowering ethanol carbon intensity for addition value in markets with carbon regulation such as California with its Low Carbon Fuel Standard. Biogenic carbon capture is a critical part of many scenarios for end-of-century carbon mitigation. Ethanol offers the benefit of relatively low cost of capture, and the challenge of relatively small volume carbon dioxide sources and thus a potentially higher transportation cost. The researchers explored several scenarios for collecting ethanol CO<sub>2</sub> via a range of pipeline routing scenarios for moving CO<sub>2</sub> to potential storage or utilization sites, estimated the cost of capture, compression and transportation, estimated the carbon intensity reduction potential, and evaluated the impacts of policies such as the California Low Carbon Fuel Standard and federal tax credits.

Presenter: **Brendan JORDAN, Great Plains Institute, Minneapolis, USA**

Presenter's biography:

Brendan Jordan has 14 years of experience leading biomass technology commercialization initiatives. He is an experienced facilitator, policy advocate, analyst, and project manager.

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Session reference: 4DO.2.3

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Greening the Charcoal Value Chain to Mitigate Climate Change

Short introductive summary:

An estimated 1–2.4 Gt CO<sub>2</sub>e of GHGs are emitted annually in the production and use of fuelwood and charcoal. This paper provides insight in the climate impacts from an unsustainable charcoal value chain and discusses key interventions for a cleaner and more efficient charcoal production and use, resulting in a considerable reduction of overall GHG emissions in the charcoal value chain. The paper will also discuss the economic impacts and benefits of a greener charcoal value chain and the policy options needed to realise uptake of these interventions.

Presenter: **Zuzhang XIA, FAO, Rome, ITALY**

Presenter's biography:

Around 30 years of professional experience in addressing energy poverty and energy access in developing countries. Currently serves as a forestry officer of the FAO, responsible for planning, coordinating and implementing wood energy activities.

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Session reference: 4DO.2.4

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## The Climate Change Impact of Second-Generation Bioenergy

Short introductive summary:

Bioenergy is expected to play an important global role in supplying energy, replacing fossil fuels and mitigating climate change in the 21st century. Large-scale bioenergy use will require purpose-grown bioenergy crops (alongside residues and wastes), the vast majority of which are expected to be second-generation lignocellulosic bioenergy crops (i.e., fast-growing grasses or woody crops), with higher yields and lower land quality requirements than first-generation food-crop feedstocks. Bioenergy may have larger climate benefits and even negative greenhouse gas emissions when combined with Carbon Capture and Storage (BECCS). Our objective is to estimate typical values and uncertainty of 1) how long it takes until second-generation bioenergy, with and without carbon capture and storage, leads to climate benefits, and 2) the size of these climate benefits, on a per hectare and per MJ fuel basis over a fixed time period. Climate benefits are determined in terms of reduced cumulative radiative forcing and second-generation bioenergy is considered at a global level, including different biomes, previous land-uses, bioenergy feedstocks, and energy carriers.

Presenter: **Steeff HANSSSEN, Radboud University, Environmental Science Dpt., Nijmegen, THE NETHERLANDS**

Presenter's biography:

I am a PhD student at Radboud University (The Netherlands). My research concerns the climate change impact of bioenergy, with a focus on electricity and transport fuels from second-generation bioenergy feedstocks. I graduated in Energy Science from Utrecht University in 2015 (MSc, cum laude).

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Session reference: 4DO.2.5

Subtopic: 4.4 Climate impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY



## **Micro-Pyrolysis of Lignin-Rich Digested Stillage from 2nd Generation Bioethanol Production: Investigation to Determine the Catalytic Effect of its Natural Ash**

Short introductive summary:

Lignin-rich digested stillage from 2nd generation bioethanol production is a unique feedstock for fast pyrolysis, not only because it contains high amounts of lignin (62 wt. % d.b) and ash (9.97 wt. % d.b) but also due to its residual cellulose and hemicellulose fractions. Qualitative analysis of this feedstock with micro-pyrolysis indicates that the pyrolysis vapours show a similarity, to some extent, with chemical compounds from pyrolysis vapours of alkali lignin, organosolv lignin and kraft lignin. Detailed analysis confirms the presence of various types of phenolic compounds, ketones, benzenes, furans, and aromatic hydrocarbons typically found in pyrolysis vapors derived from cellulose-lignin and hemicellulose-lignin mixtures.

Presenter: **Wolter PRINS, Ghent University, Bioresources Processing Dpt., Gent, BELGIUM**

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Session reference: 3DO.3.1

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Technical Modifications Improving Operational Stability at the Bioliq Fast Pyrolysis Plant

Short introductive summary:

The bioliq® process developed at KIT aims at the conversion of lignocellulosic biomass into synthetic biofuels and chemicals. The process follows a two stage concept combining de-centralized pretreatment of biomass by fast pyrolysis and centralized large scale gasification and synthesis plants. The process was specifically designed to convert ash rich feed materials, demanding for special design features at least in the front end processes.

The fast pyrolysis section of the 2 MW (500 kg/h) pilot plant at KIT was mechanically completed in 2008. In the following years, various deficiencies in the equipment were revealed. Inappropriate operating conditions and frequent failures in technical equipment made a continuous steady-state operation for several hours difficult.

After value engineering in 2013 in co-operation with Air Liquide as industrial partner, some larger modifications were implemented, improving stability of operation and relevance of results.

Usually, information on the operation of larger scale equipment is scarce. Therefore, the scope of this contribution is to present the modifications made in more detail along with their virtue and appropriateness.

Presenter: **Andreas NIEBEL, Karlsruhe Institute of Technology, Institute of Catalysis Research and Technology, Eggenstein-Leopoldshafen, GERMANY**

Presenter's biography:

Process Engineer (M. Sc.)

At KIT since 2012.

Positions:

2012-2015: Project Engineer for fast pyrolysis at KIT in the EU Project "BioBoost".

2015-today: Plant Engineer at the bioliq pilot plant. Focus on the fast pyrolysis section.

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Session reference: 3DO.3.2

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Simulation of a Tilted-Slide Reactor for the Fast Pyrolysis of Biomass

Short introductive summary:

The fast pyrolysis of sawdust in the tilted-slide reactor was simulated by a commercial computational fluid dynamics code (STAR-CCM+), and was compared with the experimental results. Lagrangian multiphase model was used to simulate the transport of sand and biomass particles, and the kinetic mechanism of biomass pyrolysis was adopted. It was found that the similar yield of volatiles is obtained when the temperature of the reactor was 540°C, which is about 50°C higher than the experiment. The numerical results can be used as base data for designing a reactor scale-up.

**Presenter:** Sang-Kyu CHOI, Korea Institute of Machinery & Materials, Dept. of Clean Fuel & Power Generation, Daejeon, REPUBLIC OF KOREA

Presenter's biography:

Dec. 2012 - Present

Senior Researcher, Korea Institute of Machinery & Materials (KIMM)

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Session reference: 3DO.3.3

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## The Energetics of Cellulose Glycosidic Bond Cleavage

Short introductive summary:

Molecular understanding of the high temperature decomposition of cellulose remains one of the leading challenges for pyrolysis researchers, with significant questions remaining with regard to global polymer conversion kinetics as well as the elementary mechanisms to form volatile organic products (i.e. bio-oils). Despite decades of effort focusing on the development of lumped kinetic models, the range of models and associated kinetic parameters is large (activation energy,  $E_a$  of 10 to 63 kcal/mol). In this work, we present two experimental methods for evaluating the chemistry and chemical kinetics of cellulose pyrolysis. The methods of "Thin Film Pyrolysis" and the "PHASR" (Pulse-Heated Analysis of Solid Reactions) allows for a chemical understanding the polymer and chemical mechanisms of cellulose conversion. The apparent activation energies and polymer kinetics of both cellulose conversion and product formation (including HMF, furfural and levoglucosan) are presented along with proposed chemical mechanisms.

Presenter: **Paul DAUENHAUER, University of Minnesota, Chemical Engineering and Materials Science, Minneapolis, USA**

Presenter's biography:

Paul J. Dauenhauer is the DuPont Young Professor and Associate Professor of Chemical Engineering and Materials Science at the University of Minnesota. He serves as Co-Director of the Catalysis Center for Energy Innovation and has worked for Cargill and the Dow Chemical Company.

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Session reference: 3DO.3.4

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Investigation of Slurries Made of Char-In-Pyrolysis Oil in Terms of Formulations, Stability, and Rheological Properties

Short introductive summary:

The work focuses on the preparation of two stable bio-slurries made of the liquid and the solid product of the pyrolysis processes of wood, respectively intermediate pyrolysis charcoal (IPC) in intermediate pyrolysis bio-oil (IPBO) and slow pyrolysis charcoal (SPC) in fast pyrolysis bio-oil (FPBO). First, slurry preparation was investigated for both formulations with the aim of studying slurring ability at different char-in-oil content. The apparent viscosity of the slurry samples resulted to be dependent on solid loading (5 - 30 wt. %), char particle size, and temperature (tested temperature up to 60 °C, to prevent bio-oil degradation), especially in the phase transition region. The other properties of slurries were investigated with respect to phase stability, rheological properties, and pumpability. The produced formulations were compared against each other, and a defined char-in-liquid content was selected for its use intermediate energy carrier.

Presenter: **Marco BUFFI, CREAR/RE-CORD, DIEF - Industrial Energy Dept., University of Florence, Florence, ITALY**

Presenter's biography:

Marco is a R&D researcher of the University of Florence and RE-CORD consortium. His research areas are focused on biofuels use and production, thermochemical processes, power generation from gas turbines and engines, and biomass cogeneration.

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Session reference: 3DO.3.5

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Logistics Options and Costs of Horse Manure from Stable to Boiler

Short introductive summary:

In Finland, the current situation regarding the combustion of horse manure is challenging. The manure can only be burned for energy in the waste burning plants that are equipped with continuous emissions measurement devices. However, there have been promised some reliefs for the combustion process of horse manure for the plant size of less than 50 MW in the near future. This prospective legislative facilitation will help the horse manure to gain a foothold as a new biofuel in the energy production. Therefore also horse manure logistics needs to be streamlined all the way from the stable to the power plant.

The logistics options and costs of horse manure were studied in the HevosWatti project. The project was implemented in the region of South Savo, in Finland. As a result of the project, information was gained on the intensification of the horse manure logistics chain and on the cost-effectiveness of the used logistics options. The main purpose of the study was to analyze and compare the alternative scenarios of the horse manure logistics. In addition, the new information was obtained on the most potential ways of managing the horse manure logistics as part of energy production.

**Presenter:** Jarno FÖHR, Lappeenranta University of Technology, Laboratory of Bioenergy, Mikkeli, FINLAND

Presenter's biography:

Jarno Föhr is a project researcher in the bioenergy research group at Lappeenranta University of Technology. His purpose is to produce new information about biomass handling and transportation methods and to analyze biomass quality within supply chains.

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Session reference: 1DV.1.1

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **Pulpwood Terminals and Their Potential to Support Biomass Supply to Power Plants in Eastern Finland**

Short introductory summary:

Dynamic agent-based simulation and GIS-analysis methods were used to find suitable locations for integrated pulpwood and energy biomass terminals in Eastern Finland. Biomass feedstock of pulp mills and power plants have different high seasons for intermediate storages, and integration could bring cost savings. The location should be optimal for both pulpwood and energy biomass logistics.

Presenter: **Olli-Jussi KORPINEN, Lappeenranta University of Technology, Laboratory of Bioenergy, Mikkeli, FINLAND**

Presenter's biography:

Olli-Jussi Korpinen, M. Sc. (For.), works as a project researcher at Lappeenranta University of Technology. His main research topics are to analyze biomass availability and sourcing with GIS-based methods and biomass logistics with simulation approach.

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Session reference: 1DV.1.3

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Maize Cob and Cereal Chaff: Feedstocks for Energy Production

Short introductive summary:

Many EU projects affirm that there is significant potential to expand the share of energy & material production from biomass in a 2020-2030 timeframe in a sustainable way and without entering into conflict with food and feed security. Furthermore, all studies agree about the necessity to unlock the potential of underutilized agricultural resources to reach the planned European bio-economy goals. Agricultural residues like maize cob and grain chaff with an annual European availability of 9.6 Mt and 54.8 Mt respectively, represent an interesting underutilized amount of potential biomass for energy production. Moreover, the harvesting logistics of cob and chaff grain are supported by equipment already available in the market. Cob and chaff are used in different industrial fields but few studies have analyzed the potential as feedstock for industrial boilers to produce energy, separately or in combination with other biomass types. The purpose of this study is to investigate the physical and chemical characteristics of chaff grain and maize cob in order to verify their potential use in industrial boilers for the production of heat and electric.

Presenter: **Alessandro SUARDI, CREA- Council for Agricultural Research and Economics, Centro di ricerca Ingegneria e Trasformazioni Agroalimentari, Monterotondo RM, ITALY**

Presenter's biography:

Temporary Research Associate at CREA-ING

Field of research:

- Agricultural mechanization
- Energy crops
- Life Cycle Assessment

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Session reference: 1DV.1.5

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES



## Physic Nut Wood: an Interesting Feedstock for Energy Production

Short introductive summary:

In order to assure the energy security, the rural development and to reduce the effects of the climate change, many countries actively promote the cultivation of energy crops which have been identified as suitable for achieving national energy and environmental targets. Physic nut (*Jatropha curcas*, L.) is a perennial oil crop cultivated in tropical and subtropical regions mainly for the production of biodiesel. Beside the oil, the pruning annually produced by *jatropha* could be a source of biomass and an extra-income for the farmers, that usually have to face with the serious problem of the residues disposal. However, few information of the physical and chemical characteristics of the *jatropha* wood are available in literature and its consequent potential behavior during the combustion in boiler is unknown. The scope of the study is to investigate the physical and chemical characteristics of the *jatropha* wood in order to verify its potential use as biomass feedstock for boilers, in order to produce heat and electricity.

Presenter: **Alessandro SUARDI, CREA- Council for Agricultural Research and Economics, Centro di ricerca Ingegneria e Trasformazioni Agroalimentari, Monterotondo RM, ITALY**

Presenter's biography:

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Field of research:

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Session reference: 1DV.1.6

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Combined Harvesting of Chaff and Straw for Bioethanol Production: the First Experience on Wheat in Sweden

Short introductive summary:

The bio-economic framework of European Union opens up some interesting options to promote the valorisation of feedstock until now considered as waste. It is the case of agricultural residues, namely residual biomasses deriving from common agricultural practices that are generally chopped in the field or disposed in different ways. The grain chaff is one of these products obtained from threshing or dehulling of different cereals such as wheat, rye, barley, oats, rice. The use of chaff as source of fuel is considered an interesting bio-energy option, but its recovery is not easy and the identification of efficient collection systems will be necessary to start a real energy chain. The present work is intended as an attempt to this challenge and represents a primary experience as part of the European project AGROinLog (<http://agroinlog-h2020.eu/en/home/>). A harvest test was performed in Sweden on the Julius wheat variety to assess the possibility to harvest chaff together with straw in bales for bio-ethanol production. Results displayed significant differences between the harvest settings adopted.

**Presenter:** **Antonio SCARFONE, Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA), Ingegneria e Trasformazioni Agroalimentari, Monterotondo (Rome), ITALY**

Presenter's biography:

Ph.D. on storage of lingo-cellulosic biomasses for energy purposes, currently working as researcher at CREA (engineering and agro-food processing centrum) performing activities related to agricultural mechanization of non-food crops and biomass storage.

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Session reference: 1DV.1.8

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **Pineapple Residues from End-Productive Plantations: Harvest Perspectives and Bioenergy Potential in Costa Rica**

Short introductive summary:

Pineapple field residue management represents a big problem in Costa Rica for different reasons. Primary, if the pineapple biomass is not well managed and quickly disposed in the first week after being crushed, the field becomes a substrate for the proliferation of stable fly (*Stomoxys calcitrans*), a hematophagous Diptera biting fly that attacks surrounding livestock for a blood meal, impacting animal welfare and farm productivity as well. Secondly, since the most common agricultural practice consists in using desiccant herbicide to burn dehydrated plants, the people concern is rising due to the potential impact of these practices on environment and human health.

Uneconomic and inefficient solution are currently adopted, which should be supported by alternative strategies to solve these problems. This paper will show a new approach aimed at managing and valorizing this biomass product in Costa Rica in future years.

**Presenter:** **Antonio SCARFONE, Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA), Ingegneria e Trasformazioni Agroalimentari, Monterotondo (Rome), ITALY**

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Session reference: 1DV.1.9

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **Exploitation of Pruning Residues along with Biological Control: a Case Study for Sweet Chestnut (*Castanea Sativa*, Mill.) Orchards in Central Italy**

Short introductive summary:

The harvest of orchard pruning residues could be worthwhile for all those minor fruit-tree species that generate abundant biomass when pruned. In Italy, sweet chestnut trees (*Castanea sativa* Mill.) are pruned on a multiple year basis, producing both firewood pieces from the lateral branches and thinner material from minor branches and shoots. The latter residue could be conveniently re-used for energy purposes, but its exploitation requires a special care when operating in chestnut orchards infested by the Asian chestnut gall wasp (ACGW), *Dryocosmus kuriphilus*, (Hymenoptera: Cynipidae), because the parasitoid *Torymus sinensis* (Hymenoptera: Torymidae) overwinters in the vacated galls. The present work reports a case study regarding the mechanization of field operations for gathering sweet chestnut prunings, while safeguarding the ecological function of the galls for the establishment of the parasitoid within the chestnut orchard.

**Presenter: Alberto ASSIRELLI, CREA - Research center for engineering and agro-food processing, Monterotondo - RM, ITALY**

Presenter's biography:

Dr. Alberto Assirelli has a PhD in Agricultural Engineering in 1997 and started working in the Department of Economics and Agricultural Engineering at the University of Bologna, continuing his works in other public and private research centers.

Researcher in the Agricultural Engineering Unit (CREA-ING) of the Agricultural Research and Experimental Council (CREA), in Monterotondo (Roma).

Author of more than 400 publications in the fields of agricultural mechanization with particular reference to the development and testing of new machinery for food, feed and energy crops.

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Session reference: 1DV.1.10

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Double-Pass Harvesting System on Giant Reed in South Italy

Short introductive summary:

The aim of this study was to evaluate the performance of two-step *Arundo donax* harvesting system in Southern Italy. The biomass was shredded, dried in the field and baled for storage. The first step was cutting and chopped biomass crops with a specific shredder for herbaceous biomass crops rear-mounted on reversible agricultural tractor. Subsequently, after some days of drying in the field monitoring continuously its moisture content, the *Arundo* biomass was harvested and baled for storage.

The tests carried out showed the technical and energy features of the harvest technology based on the adoption of only one specific shredder machine, designed and developed by an Italian constructor for more biomass herbaceous crops (*Arundo*, *Sorghum*, *Panicum*, *Mischantus*, etc).

Presenter: **Alberto ASSIRELLI, CREA - Research center for engineering and agro-food processing, Monterotondo - RM, ITALY**

Presenter's biography:

Dr. Alberto Assirelli has a PhD in Agricultural Engineering in 1997 and start working in the Department of Economics and Agricultural Engineering at the University of Bologna, continuing his works in other public and private research centers.

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Session reference: 1DV.1.12

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Techniques for Whole-Plant Removal in Peach Orchard for Energy Purpose

Short introductive summary:

Regardless of the crop form, the termination practices in permanent crops produce a significant volumes of wood biomass (trunks and stumps), which can be exploited as renewable fuel in bioenergy plants. The recovery in a single step of the whole-plant of the depleted orchard can be an interesting solution, but an adequate harvest and logistic chain would be defined. One of the main problem is the production of a "clean" feedstock, because the contamination by soil and dirty particles from stump can reduces the commercial value, until the rejection of the product. The work examined the available technologies highlighting advantages and limitations along the entire chain comprising harvesting, compaction, storing, and chipping.

Presenter: **Alberto ASSIRELLI, CREA - Research center for engineering and agro-food processing, Monterotondo - RM, ITALY**

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Session reference: 1DV.1.13

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **Assessment of Biomass Resources for an Integrated Biomass Logistics Center (IBLC) Operating in the Olive Oil Sector**

Short introductive summary:

An IBLC (Integrated Biomass Logistic Centre) is defined as a business strategy for agro-industries to take advantage of unexploited synergies in terms of facilities, equipment and staff capacities, to diversify regular activity both on the input (biomass feedstock) and output side (biocommodities & intermediate biobased feedstocks) thereby enhancing the strength of agro-industries and increasing the added value delivered by those companies. For the olive oil sector, pomace mills are the main agro-industries that can be targeted for the implementation of an IBLC concept, since they are of sufficient large size and sophistication, they have equipment (e.g. dryers) capable of handling biomass streams, they have large idle time of inactivity and, finally, they are located in areas with large untapped biomass potential from the agricultural sector, e.g. olive tree prunings.

The aim of the present paper is to assess the biomass resources that can be mobilized by an IBLC operating in the olive oil sector in Central Greece. Two main input streams are considered: wet olive pomace, which is the standard incoming stream in a pomace mill, and olive tree prunings.

Presenter: **Emmanouil KARAMPINIS, Centre for Research and Technology Hellas, Chemical Process and Energy Resources Institute, Marousi, Athens, GREECE**

Presenter's biography:

MSc. Chemical Engineer. Research Associate at Centre for Research and Technology Hellas (CERTH) since 2006. Research areas include thermochemical conversion systems for solid biofuels, biomass co-firing, biomass logistics and sustainability assessment.

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Session reference: 1DV.1.14

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **Economic Assessment of Two Cereal Residues Harvest and Transport Systems in Relation to The Distance Between the Field And the Storage Centre**

Short introductive summary:

The work has been developed under the AGROinLOG Project, aimed at demonstrating the technical, environmental and economic feasibility of Integrated Biomass Logistics Centres (IBLC) for food and non-food products. The goal is to give support to one of the agroindustries selected in the Project, a forage production factory, to build an IBLC extending the utilization of their equipment used for regular activity to new business chain based on the valorisation of agricultural residues, cereal straw and corn stalks. The purpose of this work is to evaluate the maximum distance between the fields and the storage centre from which it is more economically convenient to gather the biomass with balers instead of forage hauling equipment.

**Presenter:** **Vincenzo ALFANO, CREA - Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Monterotondo (Rome), ITALY**

Presenter's biography:

Dr. Vincenzo Alfano has got more than 10 years of research experience in the field of bioenergy. Currently he works at CREA – Consiglio per la ricerca in agricoltura e l'analisi dell'economia. Previously he has worked at ENEA achieving a huge experience in the biomass availability assessment.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 1DV.1.15

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES



## Supply Chains of Green Residues for Bioenergy Exploitation

Short introductive summary:

The main objectives of this work is the development, implementation and evaluation of biomass supply chains from green residues for the production of energy products (solid biofuels, energy) through specific field trials, testing of energy exploitation technologies and related techno-economic and environmental assessments.

For the implementation, two major categories of biomass were selected, straw and corn residues, as well as pruning, including urban tree's clearing and forest residues. The work will be implemented in three regions where there are sufficient quantities of all the residue types that concern the action. Furthermore in these areas there is already interest in the management and utilization of the residues from existing biomass utilization units or there is the possibility of using specialized equipment.

The sustainability assessment and local impacts of the supply chains, in environmental and economic terms, through life-cycle and life-cycle-cost analysis as well as socio-economic analysis, Life Cycle Analysis (LCA) and Life Cycle Cost Analysis (LCCA) will look at the entire lifecycle of the supply chain.

Presenter: **Ioannis ELEFThERIADIS, Centre for Renewable Energy Sources and Saving, Biomass, Pikermi, GREECE**

Presenter's biography:

15 years experience in R&D projects focused on fields of assessment of biomass potential at local, regional and national level, growth and productivity of several energy crops, evaluation of energy potential of fuelwood and forest residues, natural resources' remote sensing and GIS use

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 1DV.1.16

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Maize Cob Harvesting: First Assessment of an Innovative System

Short introductive summary:

In the last years, the concept of bio-economy has become a hot topic in Europe and some research programs are focused on unlocking the potential of certain biomass resources that are currently underutilised. In that sense, the maize cob has become a material of high interest since the most common practice is to leave the cobs on the soil during the harvesting of maize grains. The interest in maize cobs comes also from the fact that, according to EUROSTAT, more than 9 Mha in EU28 are cultivated yearly with grain maize and considering a yield of 1 t/ha of cob. This would mean that more than 9 Mt/yr of maize cob could be available as resource for bio-commodities such as: 1) biomass for energy 2) absorbent for animal bedding or substrate in hydroponic cultivation 3) adsorbent for production of active carbon for water treatment, among other applications 4) abrasive material for metal or wood surface conditioning.

This paper will show a new approach aimed at managing and valorizing this biomass product.

Presenter: **Alessandro SUARDI, CREA- Council for Agricultural Research and Economics, Centro di ricerca Ingegneria e Trasformazioni Agroalimentari, Monterotondo RM, ITALY**

Presenter's biography:

Temporary Research Associate at CREA-ING

Field of research:

- Agricultural mechanization
- Energy crops
- Life Cycle Assessment

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Session reference: 1DV.1.17

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **Influential Properties on Mechanical Degradation of Densified Torrefied Biomass in Large Scale Transportation and Storage**

Short introductive summary:

This paper presents the influential properties of densified torrefied biomass affecting on mechanical degradation and transportation behavior.

Presenter: **Hamid GILVARI, TU Delft, TEL, M&TT, 3mE, Delft, THE NETHERLANDS**

Presenter's biography:

I am a PhD candidate at Delft University of Technology, the Netherlands, working on transportation, logistics, and storage of densified torrefied biomass.

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Session reference: 2DV.2.2

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Biomasa de Poda de Frutales como Material Prima para Obtención de Pellets Biofuel**

Short introductive summary:

The use of biomass from pruning fruit trees to obtain biofuel pellets can be an interesting alternative in Southern Europe, generating added value in rural areas and favoring the development of the circular economy and green economy. The main characteristics of the plum pruning biomass have been studied from the energy point of view for its application as a solid biofuel in the form of pellets, analyzing the variables that determine the quality following EN standards. The results obtained in the quality parameters show that it is possible to obtain quality pellets of biomass from pruning of fruit trees, promoting the green and circular economy in rural areas where biomass is generated.

Presenter: **Luis ROYANO, CICYTEX, GUADAJIRA, SPAIN**

Presenter's biography:

My studies are agricultural engineer. Work at CICYTEX 11 years ago for the same department developing field and laboratory work (biomass characterization) and scientific reports, collaborating with companies to promote applied research.

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Session reference: 2DV.2.4

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Energy Requirement for Biomass Densification Via Mechanical Compression and an Integrated Pelletization Unit**

Short introductive summary:

Growing demand of wood pellets in global market, coupled with concern arise due to solid waste management, has drawn attention to produce more fuel pellets from non-woody biomass feedstocks. In this context, a study was done to evaluate the compression energy requirement for garden waste biomass and compared with other biomass feedstocks. In addition, the energy consumption was also measured during fuel pellets production using a pilot scale pelletization unit under different test conditions. Overall, the present study evaluated the energy requirement for garden waste densification under various experimental cases

Presenter: **PRIYABRATA PRADHAN, Indian Institute of Technology Bombay, Mumbai, INDIA**

Presenter's biography:

P Pradhan earned both of his bachelor's and master's in Agricultural Engineering. He is currently pursuing his PhD degree at Indian Institute of Technology Bombay. His research interest includes Renewable energy (Biomass), Pelletization, Gasification, Biofuels, Agriculture system.

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Session reference: 2DV.2.5

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Investigation of a Mathematical-Physical Model for Biomass Densification Depending on Geometry of Pressing Chamber**

Short introductive summary:

The main objective of research in this work is to design a mathematical-physical model of biomass densification taking into account the geometry of the pressing chamber, which allows the direct optimization of the parameters of densification in order to obtain high quality production at minimum energy demand of the production process. Application of these models into the practice allows to manage and optimize the whole densification process of wood into the form of solid biofuel.

Presenter: **Milos MATUS, Slovak University of Technology in Bratislava, Faculty of Mechanical Engineering, Bratislava, SLOVAK REPUBLIC**

Presenter's biography:

He works as a university teacher at the Slovak University of Technology in Bratislava.

Field of research: technologies for solid biofuel production, technologies for waste recovery, design of technological lines, development of briquetting and pelleting machines.

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Session reference: 2DV.2.6

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Determination of Mechanical Properties of Corncob, Hay and Cane Pellets

Short introductive summary:

The paper deals with evaluation of mechanical properties of pellets made of various types of biomass produced by granulating machine MGL 200. The biomass from agricultural production (corncoobs) and landscape maintenance (hay and cane) were used for pellet production. The pellets were submitted to compressive loading test.

Presenter: **Stefan MIHINA, Slovak University of Agriculture in Nitra, Nitra, SLOVAK REPUBLIC**

Presenter's biography:

1974 - 2005 Research Institute for animal Production in Nitra 2006 - 2008 Slovak Agriculture Research Centre in Nitra  
2014 - 2016 National Agricultural and Food Centre 2002 - 2012 director of the Agency of the Slovak Academy of  
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Session reference: 2DV.2.7

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Influence of Processing Parameters on Wood Biomass Disintegration and Pellets Production**

Short introductive summary:

Material preparation for briquettes and pellets production is really important and have very big influence to production process and also to final product condition. There is many factors which could affect final quality of biomass briquettes and pellets. Also many processes and machine settings can lead to quality change. As we know from previews research, there is really important size of biomass particles from which the pellets and briquettes are produced. Shredding machines are directly responsible for biomass size preparation. Basically there is influence of what kind of machine we use, its principle, if we use screen to define exact particle size and other parameters. All of this cause also different energy consumption and affect the process effectiveness. The paper contains measured data acquired within production process of pellets from wood particles. The data are statistically evaluated and compared with quality of pellets and others their properties. Result of this paper is statement if more energy investment to material preparation is also balanced with better pellets properties which will lead to less pellets consumption and better heating power.

Presenter: **Juraj BENIAK, Slovak University of Technology, Faculty of Mechanical Engineering, Bratislava, SLOVAK REPUBLIC**

Presenter's biography:

Assoc. Prof. Juraj Beniak, PhD. - Currently work as a vice-dean on Faculty of Mechanical Engineering, Slovak University of Technology in Bratislava. His point of interest is biomass preparation with shredding machiness or material disintegration. The second area of interest are Rapid Prototyping.

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Session reference: 2DV.2.8

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



## Modular Consumption of Briquette Press

Short introductive summary:

At the Institute of Production Systems, Environmental Engineering and Quality Management of the Slovak University of Technology, Faculty of Mechanical Engineering, we have also developed a modular concept that allows the assembly of both single-chamber and multi-chamber briquetting presses. For example, when assembling a double-chamber press, we achieve double the performance, higher energy efficiency, easier balancing of the crank mechanism, and higher usability of the built-in space. When assembling a double-chamber press with more than 78% of the parts identical to the single-chamber unit the efficiency of production is greatly increased. The aim of this paper is to describe the modular concept of a multi-chamber briquetting press.

**Presenter:** **Lubomir SOOS, Slovak University of Technology, Faculty of Mechanical Engineering, BRATISLAVA, SLOVAK REPUBLIC**

Presenter's biography:

Lubomír Šooš is currently Dean of the Faculty of Mechanical Engineering at the Slovak University of Technology in Bratislava. From 2015 to 2017 he was he was Head of the Institute of Production System, Environment Technique and Management of Quality at the Faculty of Mechanical Engineering.

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Session reference: 2DV.2.9

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Characterization of Different Leave Fractions for the Energetic Utilization

Short introductive summary:

Leaves are collected and composted at the municipal level in the course of street cleaning, park maintenance and biowaste collection. Due to the partly poor rotting properties and the relevant calorific values, the energetic use of leaves is particularly interesting for municipalities. The impact of (co-)combustion of leaves on the generated emissions has not yet been investigated systematically. For this reason, in the project "Systematic determination of emission data in the thermal conversion of different leaves waste fractions" ("SET-Laub") aims to investigate emission characteristics of different leaves fractions and mixtures with conventional woody fuel in incineration plants with a thermal output of more than 400 kW (installations requiring a permit – according to German regulation 4. BImSchV and TA Luft, the German Technical Regulations on Emissions). During incineration, possible environmental impacts (particulate matter, NOx, CO, organic and inorganic substances) should be quantified.

Presenter: **Esther STAHL, Fraunhofer-Institut UMSICHT, Process technology Dpt., Oberhausen, GERMANY**

Presenter's biography:

until 2006: study "Environmental Engineering" at RWTH Aachen/Germany

since 2006: Research assistant at Fraunhofer UMSICHT

2011: PhD, topic „Characterization of metallic micro sieves for the removal of fine particulate matter from gas streams“

since 2012: Group leader "BM and residues utilization"

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Session reference: 2DV.2.10

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Full Evaluation of Sida (Sida Hermaphrodita) Biomass as a Solid Fuel

Short introductive summary:

The perennial herbaceous mallow plant *Sida hermaphrodita* (L.) Rusby, also known as Virginia fanpetals (hereafter referred to as *Sida*) has first been described in the early 1980's. However, it took further three decades to raise awareness for its potential as an alternative biomass plant for energy purposes.

We will present data on the effect of different density cultivation scenarios on *Sida* establishment, harvest and biomass yield over a three year period at agricultural conditions. Subsequently, *Sida* biomass is investigated as a solid fuel for combustion, considering continuous combustion studies of three dried biomass forms i) shredded biomass, ii) pellets, and iii) briquettes, followed by detailed ash analysis and an overall life-cycle assessment. Incineration analysis, heating values and emissions, as well as qualitative ash analysis will provide detailed information on the suitability of *Sida* biomass as a renewable biogenic energy carrier.

Presenter: **Nicolai David JABLONOWSKI, Forschungszentrum Jülich GmbH, IBG-2, Jülich, GERMANY**

Presenter's biography:

Dr. Nicolai David Jablonowski, Research Scientist, Workgroup leader, Project coordinator, Alternative Biomass IBG-2: (FZJ). Research Interests: Plant soil interactions, Plant biomass for energy purposes; Plant biomass production on marginal soils; Nutrient recycling and chemicals in soil.

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Session reference: 2DV.2.11

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Effect of Screening on Storage Behaviour of Wood Chips

Short introductive summary:

Biological degradation processes during storage of fresh wood chips may cause high dry matter losses and a decline in fuel quality. These processes might be increased by a large amount of fines due to their relatively large surface area and high amount of easily available nutrients for microbial growth.

Therefore, the aim of this study was to investigate the effect of screening, i. e. the segregation of fines, on the storage behaviour of wood chips. Four piles of wood chips were established using two raw materials (coniferous wood chips from forest residues and from energy roundwood) and two treatments (screened and unscreened). After five months, piles were analysed for changes in fuel quality and dry matter losses.

Presenter: **Daniel KUPTZ, Technology and Support Centre of Renewable Raw Materials, Solid Biofuels Dpt., Straubing, GERMANY**

Presenter's biography:

Daniel Kuptz studied Forestry Science at Technical University of Munich (TUM) and did his PhD at the Chair of Ecophysiology of plants (TUM). He works as a researcher and as assistant manager in the department for Solid Biofuels at TFZ.

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Session reference: 2DV.2.12

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Effects of Fuel Additives on Agricultural Wastes Pellets Quality

Short introductive summary:

The current work was conducted to study the effect of two fuel additives, sulfonate lignin and marble sludge that increase the ash fusion temperature of agricultural wastes, on the physico-chemical properties of biomass pellets. During the pelletization process, additive was continuously added with addition ratio up to 4 wt%. The physical quality of the produced pellets were determined by measuring pellet density, durability and the energy used for pellets production. Additionally, influence of the additive on the general properties of the produced pellets and the ash fusion temperature were investigated. It was found that the durability of barley husk pellets were considerably improved with addition of either sulfonate lignin or marble sludge. For the barley straw, the durability of the produced pellets was increased with addition of sulfonate lignin. The pellet density increased with addition of marble sludge. The pellet density increased with addition of marble sludge for both barley straw and husk pellets. With increasing addition of both fuel additives, the melting temperature of barley straw and husk ash considerably increased.

Presenter: **Liang WANG, SINTEF Energy Research, Thermal Energy Dpt., Trondheim, NORWAY**

Presenter's biography:

Liang Wang is a research scientist at SINTEF Energy Research in Trondheim Norway. His research focuses on thermal conversion and utilization of biomass and wastes for renewable energy and green fuel production and sustainable metal production processes.

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Session reference: 2DV.2.13

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Quality Assessment of Mediterranean Biofuels

Short introductive summary:

The objective of this work is to make a quality assessment of important Mediterranean biofuels as pre-normative research with the aim of developing new quality standards and revising and adapting the current applicable ones to the characteristics of the considered biofuels. An extensive analytical work over a total of 347 samples of biofuels and biomasses previously identified as of high potential to be widely used as fuels (olive tree and vineyard prunings, olives stones and different types of fruit shells) collected across 7 Mediterranean countries has been made. The integrated statistical treatment and analysis of the results have allowed to determine relevant characteristic values of each biofuel.

It can be concluded that olive tree and vineyard prunings are not generally expected to meet the quality requirements that are currently in place in the cited ISO standards concerning ash and copper contents. The UNE standards could be applicable in at least all the European Mediterranean countries considered in this study. The work performed may significantly contribute to the sustainable market development of the studied biofuel.

Presenter: **Ruth BARRO, CIEMAT, Biomass Unit - Dpt. of Energy, Lubia (Soria), SPAIN**

Presenter's biography:

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Session reference: 2DV.2.15

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Production and Assessment of Pulverized Torrefied Biomass for Use in a Wood Dust Burner**

Short introductive summary:

Short introductive summary of approx. 1,200 characters :

The use of pulverized biomass in industrial burners is complicated by the heterogeneous and irregular nature of biomass raw materials and by the high cost of energy for size reduction. Torrefaction of biomass leads to reduced variation in proximate and ultimate fuel properties and to improved grindability in terms of specific milling energy and final particle size and distribution. This paper reports an investigation into the grindability of mixed hard wood, torrefied mixed hard wood, torrefied softwood logging residues and torrefied urban tree trimmings. The fuel properties, specific milling energy reduction and particle size distribution were assessed for use of the pulverized torrefied biomass in wood dust burner according to the technical and economic requirements of industrial heat supply. A Life Cycle Assessment of the complete process from biomass harvest to combustion and industrial heat supply was also performed

Presenter: **Raphael HAYMOZ, University of Applied Sciences and Arts Northwestern Switzerland, Institute of Bioenergy and Resource Efficiency, Windisch, SWITZERLAND**

Presenter's biography:

2003 - 2006 Business school, Bern

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Session reference: 2DV.2.16

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Densification of Olive Pit in Pellet Form

Short introductive summary:

The potential of olive pit for its mass and energy densification has been showed, obtaining a pellet with consistency, workability and a Lower Heating Value (LHV) similar to wood pellets, and having a lower ash content after combustion

Presenter: **Jose Antonio BECERRA VILLANUEVA, University of Seville, Energy department, Seville, SPAIN**

Presenter's biography:

Assistant professor in the Energy department of the University of Seville

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Session reference: 2DV.2.17

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY



## Preparation and Compaction of Wheat Chaff in Order to Supply Optimized Solid Biofuels

Short introductive summary:

The collection of chaff during harvesting makes a new biomass resource available, which can be further processed into compact biofuels by pelletizing. In a preceding sieving step of chaff, short straw can be sorted out leading to an optimized biomass fraction consisting mainly of husks. The resulting small particle size distribution of pre-sorted chaff and the increased bulk density eases the handling of the material. This allows the pellet production of pre-sorted chaff without pre-grinding. In order to find optimized pelletizing conditions pelletizing experiments under varying parameters are conducted. Optimized pelletizing conditions concerning water content, potential binder and L/d ratio of the die are found. Under optimized pelletizing conditions durable chaff pellets can be produced, which can be used as biofuel. The conditions and the process chain to supply optimized chaff pellets as biofuel are evaluated.

Presenter: **Christoph GLASNER, Fraunhofer UMSICHT, Biomass and Residues Utilization, Oberhausen, GERMANY**

Presenter's biography:

Since 2009 he is research assistant at Fraunhofer UMSICHT in the field of biomass conversion and water treatment/management. Currently, he is responsible for international projects in the field of food processing and biomass utilization.

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Session reference: 2DV.2.21

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Continuous Vacuum Technology for Drying Woodchips

Short introductive summary:

This article is focused on processing wooden biomass, especially woodchips. Production and processing of wooden biomass involves working with material with many different structures and qualities. Basic mechanical properties are defined. The technological application of woodchips deals with the humidity of the input material. Drying in a vacuum is an effective way of processing wood. Current technology for woodchip drying was described during EUBCE2017. This article is focused on the next generation of vacuum technology, the continuous regime of vacuum processing. Requirements are solved here and the article describes the development process. Fluid flows are simulated and solved by CFD solvers. Solutions and results are shown.

Presenter: **Vaclav MAREK, University of West Bohemia, Mechanical Engineering Dpt., Pilsen, CZECH REPUBLIC**

Presenter's biography:

I am student of PhD studies at University of West Bohemia in Pilsen, faculty of mechanical engineering. My fields of interest are: machine design, CDF and FEM simulations and CAE systems. I am interested also in energy efficiency and research in this field.

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Session reference: 2DV.2.24

Subtopic: 2.1 Production and supply of solid biofuels

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Feedstock Composition and Biogas Yield: a Review

Short introductive summary:

This paper discusses potential use of biomass feedstock including MSW, energy crops, field residues, and industrial residue streams for biogas production. Feedstock composition is the major determining factor of its biogas potential and decomposition (hydrolysis) rate. It evaluates alternative ways to express biogas yield potential and provides recommendations for an integrated approach combining biochemical methane potential (BMP) with feedstock composition to better evaluate biogas yield per unit of Fresh Matter. This contributes to a more reliable evaluation of feedstock biogas potential.

Presenter: **Hans LANGEVELD, Biomass Research, Bennekom, THE NETHERLANDS**

Presenter's biography:

I am passionate about getting more value from residues, sustainable land use and biomass production. Nearly 30 years experience in analysing cropping systems, land use and renewable energy. Background in agronomy. Founder of Biomass Research, consultant, author and chair.

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Session reference: 2DO.4.1

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Anaerobic Digestion of Grape Pomace: Effects of Biochemical Components on Methane Production and Process Intensification Using Several Pretreatment Conditions**

Short introductive summary:

Grape pomace (GP) is a promising potential source of methane, addressing consequently two issues: green energy production as well as waste management and valorization. However, the influence of biochemical parameters on the anaerobic digestion (AD) of different GP varieties has never been investigated for their valorization as an alternative energy source. Therefore, our research aimed first to define the main biochemical components of nine varieties of GP originating from different French and Lebanese wine-growing areas and to evaluate their maximal methane production in batch mode. The possible correlations between the parameters were explored using statistical methods. Our results showed that pretreatments before AD seem to be necessary in order to reduce the recalcitrance of lignocellulosic fractions and thus increase methane production. Here in, we have assessed the impact of selective pretreatment methods, such as freezing, chemical pretreatments (acid and alkaline) and physical pretreatments (ultrasounds and pulsed electric fields). Their corresponding effects on methane production and their impact on the main lignocellulosic components were investigated.

Presenter: **Jean EL ACHKAR, Saint Joseph University of Beirut, Beirut, LEBANON**

Presenter's biography:

I hold a PhD in "Engineering Sciences" from the University of South Brittany in France and a PhD in "Life Sciences" from Saint Joseph University of Beirut in Lebanon. Currently, I am working on technologies for converting biomass into green energy, particularly by anaerobic digestion.

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Session reference: 2DO.4.2

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **A Review: Characterization Methods for Evaluating the Bioaccessibility of Lignocellulosic Substrates after Pre-Treatment in Anaerobic Digestion Processes**

Short introductory summary:

The aim of this review is to investigate how and when certain chemical and physical properties of lignocellulosic materials, that previous studies have shown to be rate limiting for the methane production in AD processes, can be analyzed in order to evaluate the effect of a pre-treatment method.

Presenter: **Mirjam VICTORIN, Lund University, Department of Chemical Engineering, Lund, SWEDEN**

Presenter's biography:

I started my PhD studies in April 2016, with focus on characterization methods for lignocellulosic biomass in biogas production processes. Previous to that, I finished my master degree in bioprocess engineering within the same subject.

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Session reference: 2DO.4.3

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Effects of Alkaline and Beating Pretreatment on Anaerobic Digestion of Distillery Co-Products

Short introductive summary:

Whiskey distillery co-products are a high strength organic waste, typically consisting of pot ale (liquid waste) and draff (solid waste). Treatment and disposal of these waste streams is important from an environmental and economic point of view. Anaerobic digestion of pot ale and pot ale draff mixture (with 5:1) ratio has been performed after application of alkaline and beating pretreatments in order to improve the digestibility of the substrate. Using a Response Surface Methodology (RSM) approach, different digestion temperatures (32-35-38°C), beating times (0-7.5-15 minutes) and sludge percentages (10-30-50 %) were assessed in batch mode, focusing on maximizing the yield of biogas. Alkaline pretreatment was applied first by using 1M NaOH solution up to pH 10, based on significant results have been obtained from the preliminary experiments.

Presenter: **Burcu GUNES, Dublin City University, School of Biotechnology, Dublin, IRELAND**

Presenter's biography:

A chemical engineering graduate, currently working as a PhD student in Ireland. My research focuses on optimisation of anaerobic digestion of whiskey distillery co-products. My previous research has also focussed on production and evaluation of novel adsorbents.

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Session reference: 2DO.4.5

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## Environmental Impact Assessment of Combined Biochar & Bioenergy Production

Short introductive summary:

Biochar can be used as energy carrier, filter, animal feed ingredient, soil improver; the use of biochar as a peat substitute along with its potential for carbon sequestration offers new opportunities for sustainable residual biomass use and CO<sub>2</sub> sequestration. The product gas provides sustainable district or greenhouse heating. The use of biochar produced from residual wood as a horticulture substrate can provide growers an environmentally responsible green-waste disposal method and supplement substrate and energy requirements. By converting agro - residues into and biochar, high salt containing biomass residues, not suitable for combustion due to ash slagging and fouling, can still be used for heat generation while the nutrients become available as a soil improver and in addition enriching the soil carbon sink.

Presenter: **Lydia FRYDA, Energy Research Centre of the Netherlands, Bioenergy and Energy Efficiency, Petten, THE NETHERLANDS**

Presenter's biography:

Lydia Fryda (PhD Mechanical Engineering 2006, NTU Athens) is working for ECN since 2007, on advanced coal & biomass combustion, oxyfuel combustion, gasification of biomass and gasification towards biochar and bioenergy. Recently engaged in LCA work.

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Session reference: 4DO.5.1

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Using Digestate as Organic Fertilizer: Perspectives and Limitations

Short introductive summary:

Bioenergy is a basic part of renewable energy technologies needed to realise climate change objectives. There is an increasing focus on the production and use of biogas from anaerobic digestion (AD) using a range of feedstocks and on the use of digestate as a solution to improve and guarantee food security and natural resources management. This paper provides an overview of the ability of digestate to provide nutrients and organic matter to the crop and soil, as well as risks for contamination with pathogens or heavy metals.

Presenter: **Wolter ELBERSEN, Wageningen Research, Food and Biobased Products Dpt., Wageningen, THE NETHERLANDS**

Presenter's biography:

Wolter Elbersen (1964) is a biomass and bioenergy expert working at Food & Biobased Research of Wageningen University and Research. He has more than 20 years of working experience in bioenergy, biomass production, biomass crops, by-product and waste valorisation and biomass chain development and assessment. In recent years he has contributed or coordinated projects in The Netherlands, EU and abroad (Brazil, Ukraine, Turkey, Suriname, Colombia, and Mozambique). He is a member of the Dutch Commission on Biomass Sustainability and organiser of professional biomass courses for industry and policy makers in The Netherlands.

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Session reference: 4DO.5.2

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY



## Particulate and Gas Emissions of a Fast-Pyrolysis Bio-Oil Operated District Heating Boiler

Short introductive summary:

Fast pyrolysis bio-oil (FPBO) made of biomasses is currently planned to replace fossil oil in energy production, such as in fossil oil -fired heating boilers. This fuel change can lead to differences in emission quantities and characteristics, and to different requirements for flue gas filters in boiler plants. This work is the first detailed emissions study to measure and characterize particulate emissions from a real-scale commercially operated FPBO boiler plant. Particulate and gas emissions were measured upstream and downstream of a flue gas filter, and size-fractionated particulate samples were collected for extensive chemical analyses in order to quantify emission factors of both regulated and non-regulated emission components, and to investigate the particulate formation mechanisms. Furthermore, a wide range of toxicological properties of the emission particles were analysed to assess the potential of the emissions particles to cause adverse health effects. Finally, the results were compared to emissions data from fossil oil- and wood-fired boilers to discuss the effects of fuel changing on potential environmental effects and requirements for flue gas cleaning.

Presenter: **Olli SIPPULA, University of Eastern Finland, Environmental and Biological Sciences Dpt., Kuopio, FINLAND**

Presenter's biography:

Dr. Olli Sippula is a research manager at the University of Eastern Finland. He has studied combustion emissions for more than 15 years. The recent research topics include development of particle emission reduction technologies and physico-chemical characterization of combustion emissions

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Session reference: 4DO.5.3

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Life Cycle Assessment of Waste Wood Combustion -The Effect of Additives to Reduce Corrosion Problems in Heat and Power Generation**

Short introductive summary:

Combustion of waste wood in bioenergy power plants produce operational problems related with slagging, fouling and corrosion of different boiler elements severely affecting the energy efficiency and the lifetime of the boiler. This study presents a life cycle assessment (LCA) of four combined heat and power (CHP) power plants in Europe using different fuel mixes. The goal of the study is to explore the main parameters affecting the environmental impacts of energy generation with waste wood, with a focus on the effect of different additives in the environmental profiles of the investigated power plants. The results indicate that power plants with higher rate of waste wood in their fuel blends present higher environmental impacts in the operation phase due to polluting emissions. Although the use of additives increase the energy efficiency (and therefore the total life cycle impacts), they do not produce a significant effect on reducing the impacts of the final combustion emissions. However, additives have impact reduction potential when reducing the amount of additives used in flue gas cleaning.

Presenter: **Blanca CORONA, Utrecht University, Copernicus Institute of Sustainable Development, Utrecht, THE NETHERLANDS**

Presenter's biography:

I obtained my M.Sc. and Ph.D. degrees in Environmental Engineering at Technical University of Madrid. My actual position is as postdoctoral researcher at the Copernicus Institute of Sustainable Development, in Utrecht University.

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Session reference: 4DO.5.4

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Impact of the Use of Wood Stoves on Indoor Air Content of Particles, Carbon Monoxide and Nitrogen Oxides**

Short introductive summary:

The objective of this study is to characterize the impact, on indoor air quality, of the use of two separate wood stoves, one recent and airtight and the other of old generation, taking into account airtightness and ventilation of the housing. Indoor air pollutants studied are: CO, NOX, PM10, PM2.5, PM1 and PM0.1 with associated particle composition in PAHs, EC, OC, TC and levoglucosan.

The results obtained show that the use of a wood-burning stove is a source of indoor air particles, as well as carbon monoxide in small quantities for the oldest appliance. It also shows that air quality degrades when air renewal is reduced, with an increase in the particulate content (for similar operating conditions of the appliance) when the ventilation rates are decreased and the airtightness of the housing is increased. De-ashing periods, when carried out under good conditions, are not emitters of gaseous or particulate pollutants, while refuelling periods can be sources of particles depending on the technology of the appliance. Finally, it appears that the indoor air content of nitrogen oxides is not correlated with the use of a wood-burning appliance, but linked to external sources

Presenter: **Céline LE DREFF - LORIMIER, CSTB, CAPE/VAC, NANTES CEDEX 3, FRANCE**

Presenter's biography:

Engineer and Doctor in Process Engineering, Céline LE DREFF - LORIMIER is working since 2007 at the Scientific and Technical Center for Building (CSTB) on emissions of gaseous and particulate pollutants generated by the combustion of biomass (in small scale appliances) and how to reduce them.

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Session reference: 4DO.5.5

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **CALIBRA: CAscading Lignin BioRefinery Approach**

Short introductive summary:

CALIBRA involves a pyrolysis-based technology, featuring flexible feeding protocols, reactor concepts and product recovery protocols of the full-chain conversion of lignin up to its application as aromatic fuel and bitumen (additives) or as feedstock for the extraction of value-added phenols. The focus is on the creation and testing of novel product recovery and upgrading concepts based on the staged condensation of the primary pyrolysis products.

Presenter: **Paul DE WILD, Energy Research Centre of the Netherlands, Biomass & Energy Efficiency Dpt., Petten, THE NETHERLANDS**

Presenter's biography:

Paul works as senior scientist biorefinery at the Energy research Centre of the Netherlands (ECN), where his main activities deal with innovative thermochemical conversion technologies for biomass within the framework of the biorefinery approach.

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Session reference: 3DO.6.1

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Application of Steel Industry Slags as Novel Cost Efficient Catalysts in Catalytic Fast Pyrolysis of Biomass

Short introductive summary:

Steel industry slags were applied as catalysts for catalytic fast pyrolysis. They were used both as unmodified and modified to improve the catalytic properties. Slags were tested in catalytic pyrolysis applying analytical pyrolysis equipment as well as bench scale pyrolyser. Results indicate that these slags can act as acid catalysts in catalytic fast pyrolysis. Therefore steel industry slag offer a new cost efficient catalyst alternative for catalytic fast pyrolysis.

Presenter: **Juha LEHTONEN, VTT, Sustainable energy and chemical technology, Espoo, FINLAND**

Presenter's biography:

Dr. Juha Lehtonen is research professor at VTT for area Sustainable energy and chemical technology. He has a long career in industrial research organizations as a specialist of chemical reaction engineering, catalysis and development of biofuels, oil refinery and specialty chemicals processes.

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Session reference: 3DO.6.2

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Technical and Economic Optimization of Biomass-to-Liquid Processes Using Exergoeconomic Analysis

Short introductive summary:

Currently, advanced biofuels are characterized by high fuel production costs, resulting in low competitiveness on the fuel market. In order to reduce production costs, it is indispensable to identify and quantify cost reduction potentials within biofuel production processes. For this purpose, it is important to understand and illustrate the cost flows and cost incurrence in Biomass-to-Liquid (BtL) applications. This can efficiently be done applying exergoeconomic methods.

In this study, the exergoeconomic methodology is applied on the production of green Fischer-Tropsch biofuels from biomass and electrical power. Arising costs are broken down in avoidable and unavoidable fractions as well as in costs related to capital investments (CAPEX) or efficiency losses. As a result, recommendations are given where financial support for technology development will result in highest fuel cost reduction. Detailed cost flow diagrams of the investigated green Fischer-Tropsch processes will be presented and discussed.

Presenter: **Friedemann Georg ALBRECHT, DLR - Institut für Technische Thermodynamik, Stuttgart, GERMANY**

Presenter's biography:

2008-2012 Bachelor degree in energy and process engineering from the Technical University of Munich (TUM)  
2012-2014 Master degree in renewable energy technologies from the Technical University of Denmark (DTU)  
2015- now Research Assistant at German Aerospace Center (DLR)

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Session reference: 3DO.6.3

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Standard Liquid Fuel for Industrial Boilers from Used Wood

Short introductive summary:

The purpose of the research was to validate if the fast pyrolysis bio-oils (FPBO) from used wood would meet the specifications set by the standard EN 16900-2017 for industrial boilers. Commercial used wood was used for fast pyrolysis. Prior pyrolysis studies, the sample was grinded, dried, and sieved. The wood fraction was pyrolyzed in a 1 kg/h bubbling fluidized bed pyrolysis unit. Organic yields were lower (42-47 wt%) than with sawdust (62 wt%) but at the same level than those with stored forest residues (46 wt%). The side products char and gases are combusted for process energy in commercial integrated process. The liquid product was in two phases as predicted based on ash content of the feedstock. The phases were mixed together, and a part of water was gently removed to water content of 21 wt%. The liquid product was homogenous fluid, which met the demands of the EN standard and hence can be used in industrial boilers. The product met also the specifications for REACH.

Presenter: **Christian LINDFORS, VTT Technical Research Centre of Finland, Espoo, FINLAND**

Presenter's biography:

Christian has over 10 years experience in thermal and catalytic fast pyrolysis, bio-oil upgrading, and co-refining. The main focus of his research is on production of transportation fuels from biomass. Recently he has experienced also on thermolysis of plastics and other waste materials.

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Session reference: 3DO.6.4

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## To-Syn-Fuel: Turning Sewage Sludge into Fuels and Hydrogen

Short introductive summary:

TO-SYN-FUEL is a project funded by Horizon 2020 EU's new research and innovation programme, with the aim to build-up, operate and demonstrate the production of Synthetic Fuels and Green Hydrogen from waste biomass.

In December 2016 the European Commission has released its proposal for the RED II, the Renewable Energy Directive for the post 2020 period. This proposal introduces a gradual phase-out of conventional biofuels and sets a minimum target for advanced biofuels for transports. Therefore, there is an urgent need to bring innovative biofuels from sustainable raw materials to the market.

Twelve SME, industrial, and scientific partners, co-ordinated by Fraunhofer UMSICHT, are participating in a new ambitious research project named TO-SYN-FUEL which will build up, operate and demonstrate the production of Synthetic Fuels and Green Hydrogen from waste biomass. Building and extending from previous framework funding, the project is designed to set the benchmark for future sustainable development and growth within Europe and will provide a real example to the rest of the world of how sustainable energy, economic, social and environmental needs can successfully be addressed.

Presenter: **Andreas APFELBACHER, Fraunhofer-Institut UMSICHT, Renewable Energy Dpt., Sulzbach-Rosenberg, GERMANY**

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Session reference: 3DO.6.5

Subtopic: 3.2 Pyrolysis

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Parametric Optimization of the Pre-Treatment of South African Corncob in Molten ZnCl<sub>2</sub> Tetra Hydrate Salt

Short introductive summary:

As a follow-up to the recent report on the effect of water of crystallization of ZnCl<sub>2</sub> hydrated salt on the pre-treatment of South African corn cob [3], this study reports the parametric effect and optimization of the pre-treatment of South African corn cob in ZnCl<sub>2</sub> tetrahydrate salt using response surface methodology approach. The process variables considered during the pre-treatment were temperature, time and ZnCl<sub>2</sub> loading/concentration. Results of the one-way ANOVA on the developed model reiterated the statistical significance of the model to explain the parametric effect with a reliability of 92.5 %, suggesting an error margin of 8%. The optimization study, via multi-objective numerical optimisation approach, yielded optimal time, temperature, and solvent-to-solid ratio of 90 minutes, 107 °C, and 18 g/g, respectively, for the recovery of a highest sugar yield of 90%. These results were corroborated with the outcome of the cross-validation.

Presenter: **Michael DARAMOLA, University of the Witwatersrand, School of Chemical and Metallurgical Engineering, Johannesburg, SOUTH AFRICA**

Presenter's biography:

I am an Associate Professor of Chemical Engineering in the School of Chemical & Metallurgical Engineering at the University of the Witwatersrand, Johannesburg, South Africa. I am a Chartered Chemical Engineer (C.Eng.) and a member of the Institution of Chemical Engineers (IChemE) UK.

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Session reference: 1DV.3.3

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **Ensiling of the Pulp Fraction after Biorefining of Grass into Pulp and Protein Juice**

Short introductive summary:

This study is concerned with the possibilities for ensiling of the pulp fraction after extraction of protein juice from grass biomass. Experimental work included lab-scale and pilot-scale ensiling experiments, focusing on the importance of time from processing to ensiling as well as the effect of addition of water soluble carbohydrates. Measurements included Measurement of mass loss and effluent run-off as well as analysis of pH, volatile fatty acids, protein, amino acids and biochemical methane potential.

Presenter: **Henning JORGENSEN, University of Copenhagen, Copenhagen, DENMARK**

Presenter's biography:

Henning Jørgensen, Associate Professor at University of Copenhagen, has for more than 15 yrs worked with biorefining and particularly production of bioethanol from lignocellulosic materials. Danish national task leader IEA Bioenergy Task 39 and 42.

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Session reference: 1DV.3.5

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **Duckweed-Concept for Protein Including Removal of Nutrients in Aquatic Environ-Ments**

Short introductive summary:

A new concept for the purification and maintenance of rainwater basins and small lakes for collecting surplus water from precipitation is based on growth of duckweed and using this biomass offensively as well. The concept is based on harvesting duckweed by skimming of the biomass in the water surface, dewatering and extract of the protein for animal feed purposes. The goal has been to development a simple efficient method/concept for removal of nutrients in aquatic environments and at the same time utilize a valuable biomass resource with high content of protein.

Presenter: **Bodil Engberg PALLESEN, Danish Technological Institute, AgroTech Dpt., Aarhus N, DENMARK**

Presenter's biography:

BDP works as a Senior Consultant at Technological Institute, AgroTech. Areas: Plant fibres, Biomaterials, Biomass for bioenergy, Value chain of biomass, Bio-Economy, Business Development and Innovation, Project management

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Session reference: 1DV.3.6

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **New Treatment of Residuals From Coffee In Costa Rica. - Organic Waste- and Resource Management in the Context of Nama Café De Costa Rica.**

Short introductive summary:

Costa Rica has set itself the goal of becoming carbon neutral by 2021. To reach its ambitious climate targets, the country has put in place extensive strategies and action plans, including Nationally Appropriate Mitigation Actions (NAMAs) in a range of different sectors. Coffee production is an integral part of the nation's history and identity, and the sector is very well structured. Costa Rica is now seeking to become one of the first countries in the world to promote climate-smart coffee cultivation. In view of the high production costs and the level of global competition, the economic sustainability of this endeavour will depend on superior quality, improved resource and cost efficiency, increased product differentiation and access to new markets. German Agency for International Cooperation (GIZ) established a NAMA support project: Low-carbon coffee Costa Rica. The treatment of residuals from coffee production is investigated and optimized. Emissions from current status quo is calculated, measured and balanced. New treatment variants are evaluated and implemented in practise. Reduction of climate relevant emissions is calculated for the pilot region and for the whole country.

Presenter: **Gerold HAFNER, University of Stuttgart, ISWA - Institute for Sanitary Engineering, Water Quality and Solid Waste Management Dpt., Stuttgart, GERMANY**

Presenter's biography:

Civil and Environmental Engineer, graduated 1992; since 2003 University of Stuttgart; since 2009 Head of Department: "Resources Management and Industrial Wastes" at University of Stuttgart

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Session reference: 1DV.3.11

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **A Novel Less Consuming-Time Methodology for the Characterization of Lignocellulosic Materials in Biorefinery Processes: TGA/DTG and Predictive Kinetic Models Method**

Short introductive summary:

An innovative analysis methodology based on thermogravimetric analysis (TGA/DTG) and predictive kinetic models (PKMs) has been developed in order to calculate the % weight composition of cellulose, hemicellulose, lignin and tannin in agroforestry biomass samples, by means of the study of thermal behavior and experimental data and its correlation with the kinetics parameters in slow pyrolysis reactions

Presenter: **Raul PIÑERO HERNANZ, CARTIF Foundation, Chemical Process and Biofuels, Valladolid, SPAIN**

Presenter's biography:

Chemical Engineer (Master of Science), University of Valladolid, (Spain), 1996-2002.

Ph.D (Hons) Processes and Systems Engineering, University of Valladolid (Spain) 2007.

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Session reference: 1DV.3.16

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Non-Linear Modeling of Hydration Lignocellulosic Biomass Using Modified Langmuir Isotherms

Short introductive summary:

Lignocellulosic biomass (LB) pre-treatment is considered a very important biorefining stage for producing biomaterials and biofuels. LB mechanical, hydration, rheological, adsorption and absorption properties, particle size, etc, impact on pre-treatments performance. The objective of the work is to explain the hydration of LB as a function of particle size for four different types of LB .

Presenter: **Ramón PUENTE, Centro de Investigación y de Estudios Avanzados del IPN, Bioenergy Futures Laboratory, Zapopan, MEXICO**

Presenter's biography:

Chemical Engineer, Project Manager and Researcher Assistant at Centro de Investigación y de Estudios Avanzados del IPN, Unidad Guadalajara, Jalisco, México. Experience in lignocellulosic biomass pretreatment for the bioproducts and biofuels production.

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Session reference: 1DV.3.18

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## Biomass Quality of Different Species after Storage

Short introductive summary:

Fast growing trees planted as Short Rotation Coppice (SRC) are an important source of lignocellulosic biomass, due to their high yields, good combustion quality, ecological and social benefits and relatively low production costs. Chips are used in power stations, combined heat and power plants (CHP), biogas stations, large heating plants and small combustion units.

The harvesting systems currently available are "single pass cut and chip", operated by using large size forage harvesters, and "whole stem". The last one implies the use of forest chippers an intermediate stocking period between cutting (first step) and chipping (second step). Differently from the first one, the whole stem favors the natural drying, minimizing wood decay and dry matter losses, but the characteristics of the product that we could obtain chipping the dried biomass can change with the species considered.

In 2015, the Department of Agriculture of the University of Naples Federico II and the Research center for engineering and agro-food processing of the Council for agricultural research and economics (Crea), carried out some tests directed to evaluate the quality of the chips obtained by eight di

Presenter: **Alberto ASSIRELLI, CREA - Research center for engineering and agro-food processing, Monterotondo - RM, ITALY**

Presenter's biography:

Dr. Alberto Assirelli has a PhD in Agricultural Engineering in 1997 and start working in the Department of Economics and Agricultural Engineering at the University of Bologna, continuing his works in other public and private research centers.

Researcher in the Agricultural Engineering Unit (CREA-ING) of the Agricultural Research and Experimental Council (CREA), in Monterotondo (Roma).

Author of more than 400 publications in the fields of agricultural mechanization with particular reference to the development and testing of new machinery for food, feed and energy crops.

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Session reference: 1DV.3.19

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **Prediction Model for the Seed and Oil Yield of Pongamia (Milletia Pinnata)**

Short introductory summary:

This study addresses the major knowledge gap on seed and oil yield of Pongamia, a promising biofuel tree species, by constructing a yield prediction model based on a set of key biotic and abiotic indicators.

Presenter: **Floris DALEMANS, KU Leuven, Earth and Environmental Sciences, Leuven, BELGIUM**

Presenter's biography:

PhD researcher investigating tree-based bioenergy systems in developing countries. Research focus on econometric, statistical and experimental models for evaluation and prediction. Field experience in India, Tanzania and Kenya.

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Session reference: 1DV.3.21

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES



## **Sustainable Use of Forestry Residues for Bioenergy Generation: A Case Study from Australia.**

Short introductory summary:

The main purpose of the work was to derive more accurate estimates of biomass availability, costs of delivery and sustainability of extraction for an important forestry region in the State of NSW. The ultimate aim was to provide prospective investors with greater confidence in investing in bioenergy projects in the region. This project has demonstrated the potential for the biomass that is currently under-utilised or wasted in the forest industry to be used as bioenergy or in other applications.

Presenter: **Fabiano XIMENES, New South Wales Department of Primary Industries, Forest Science Centre, Parramatta, AUSTRALIA**

Presenter's biography:

Fabiano Ximenes is a Senior Research Scientist, working on a range of projects involving carbon, biomass and bioenergy for the last 18 years. Fabiano was one of the Lead Authors of the Harvested Wood Products Chapter of the 2013 IPCC Good Practice Guidance.

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Session reference: 1DV.3.22

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **Biomass Residues as 21st Century Bioenergy Feedstock - A Comparison of Eight Integrated Assessment Models**

Short introductive summary:

In the 21st century, modern bioenergy is expected to become one of the largest sources of energy, partially replacing fossil fuels and contributing to climate change mitigation. Agricultural and forestry biomass residues form an inexpensive bioenergy feedstock with no allocated land-use requirements and land-use associated greenhouse gas (GHG) emissions. In this study, we explore the cost-effective quantity of biomass residues supplied (subject to economic and ecological constraints) and their share in the total bioenergy supply over the course of the 21st century in eight state-of-the-art integrated assessment models (IAMs). We analyse inter-model variability and determine how the quantity and share of residues depend on: the demand for modern bioenergy, climate change mitigation policy in the form of a price on GHG emissions, land protection efforts, and the price of biomass. We also compare the quantity of residues supplied in IAMs with bottom-up estimates of residue availability in literature, to evaluate if the role of residues as 21st century energy source in different IAM scenarios matches expected availability.

Presenter: **Steef HANSSEN, Radboud University, Environmental Science Dpt., Nijmegen, THE NETHERLANDS**

Presenter's biography:

I am a PhD student at Radboud University (The Netherlands). My research concerns the climate change impact of bioenergy, with a focus on electricity and transport fuels from second-generation bioenergy feedstocks. I graduated in Energy Science from Utrecht University in 2015 (MSc, cum laude).

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Session reference: 1DV.3.23

Subtopic: 1.2 Biomass feedstock, residues and by-products

Topic: 1. BIOMASS RESOURCES

## **Xylan Depolymerization Rate in a Pretreatment Continuous Tubular Reactor**

Short introductive summary:

In this work, the synergy effect on four lignocellulosic biomasses of 3 pretreatments carried out in a continuous tubular reactor are reported.

Residence time and biomass source are control variables. Xylan depolymerization rate is the response variable.

Presenter: **Arturo SANCHEZ, Centro de Investigacion y de Estudios Avanzados del IPN, Bioenergy Futures Laboratory, Zapopan, MEXICO**

Presenter's biography:

(B.Sc. Chem. Eng., 1985; M. Chem. Eng., 1989; Ph.D., 1994). He is currently a Senior Scientist at Cinvestav-Gdl, Mexico. His research interests include advanced biofuels process engineering.

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Session reference: 3DV.4.3

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Effect of Integrated 1st and 2nd Generation Bioethanol Production on DDGS Production

Short introductive summary:

Integrating 1st and 2nd generation bioethanol production can have beneficial effects on both processes. It could however have a detrimental effect on the production of DDGS, an animal feed coproduct from the 1st generation process. The aim of this project is to investigate how integration might affect the DDGS coproduct stream.

Presenter: **Michael PERSSON, Lund University, Chemical Engineering, Lund, SWEDEN**

Presenter's biography:

I got my Masters degree in Chemical Engineering at Lund University in 2015. In 2016 I started my PhD studies at the same department, the project revolves around resource efficient production of ethanol from biomass.

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Session reference: 3DV.4.5

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Giant Reed and Milk Thistle Sugar Yield After Alkaline Pre-Treatment and Enzymatic Hydrolysis in Comparison with Standard Wheat Straw**

Short introductive summary:

There is currently an increasing interest on using lignocellulosic feedstocks to obtain fermentable sugars for biorefinery purposes (biofuel, biochemicals, bioplastics etc.). The perennial grass giant reed (*Arundo donax* L.) and milk thistle (*Silybum marianum* Gaertner) present the advantages of low agronomic input requirements and high productivity in the Mediterranean area. These feedstocks need to be pre-treated prior to enzymatic hydrolysis in order to release fermentable sugars. Our study sheds light on the recoverable total sugars from the two lignocellulosic feedstocks in comparison to standard wheat straw after alkali pre-treatments of different intensities and enzymatic hydrolysis.

Presenter: **Enrico CEOTTO, CREA- Council for Agricultural Research and Economics, Research Centre for Agriculture and Environment, Bologna, ITALY**

Presenter's biography:

Enrico Ceotto is Senior Researcher Agronomist at the Research Center Agriculture and Environment, located in Bologna, Northern Italy. Currently, his research activity is focused on perennial energy crops and their ecosystem services. E-mail address: [enrico.ceotto@crea.gov.it](mailto:enrico.ceotto@crea.gov.it).

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Session reference: 3DV.4.8

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Study of the Influence of Temperature and Alkaline Concentration in a Thermo-Mechano-Chemical Pretreatment to Enhance the Enzymatic Hydrolysis of Corn Cob and Husk for Bioethanol Production**

Short introductive summary:

Within the framework of BABET-REAL 5 project, the influence of the temperature and the alkaline concentration in a thermo-mechano-chemical twin screw extruder for enzymatic hydrolysis of corn cob and husk were studied in this work. During this treatment, the raw biomass is introduced in a twin screw extruder, passing through an alkaline treatment zone and a neutralization zone. The aim of this study is to obtain a high enzymatic hydrolysis yield while decreasing the use of alkaline and acid. Dohelert's experimental design with the two parameters was studied in a temperature range of 100-170°C and an alkaline concentration of 0.5 to 2.0 mol OH-/kg dry raw biomass. An 80% yield was attained using less chemicals and increasing the treatment's temperature.

Presenter: **Monica FONG, INPT, TOULOUSE, FRANCE**

Presenter's biography:

PhD student at Institut National Polytechnique of Toulouse since 2016. She has a scientific background in plants biotechnologies (master degree).

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Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Evaluation of Physiological Response to Furan Derivatives Stress by *Kluyveromyces Marxianus* SLP1 in Ethanol Production

Short introductive summary:

The yeasts used in the production of second generation ethanol are affected by inhibitory compounds as 5-hydroxymethylfurfural (HMF) and furfural that are releasing during the hydrolysis step; these compounds affect the fermentative capacities of the yeast. To find new yeast strains with outstanding capacities to be used in the production of second generation ethanol; in this study, we evaluated the physiological response to furan derivatives stress by native yeast *Kluyveromyces marxianus* (SLP1), and compared it with the commercial yeast *Saccharomyces cerevisiae* ethanol red (ERD). We used a chemically defined medium added with HMF and furfural at different concentrations; a control condition without inhibitors, and four stressing conditions, HMF 7 gL<sup>-1</sup>, furfural 3gL<sup>-1</sup>, HMF 3.5 gL<sup>-1</sup> with furfural 1.5 gL<sup>-1</sup>, and HMF 7 gL<sup>-1</sup> with furfural 3 gL<sup>-1</sup>. *K. marxianus* exhibited a greater capacity to assimilate the inhibitory compounds in less time than *S. cerevisiae* ERD; also, *K. marxianus* SLP1 strain showed better behavior to produce ethanol on inhibitory conditions. Despite the effects provoked by the inhibitory compounds, the yeasts could produce ethanol over 80% of conversion.

Presenter: **Lorena AMAYA-DELGADO, CIATEJ AC, Industrial Biotechnology, Zapopan, MEXICO**

Presenter's biography:

Dr Lorena Amaya-Delgado completed her doctorate in Biotechnology (CINVESTAV IPN, Mexico). She works in design, production, purification, characterization and immobilization of native and recombinant enzymes of biotechnological interest, using traditional methods and genetic engineering.

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Session reference: 3DV.4.11

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Brewer's Spent Grain as a Potential Raw Material for Butanol Production. Influence of Autohydrolysis pH in Monosaccharides Release**

Short introductive summary:

Brewer's spent grain (BSG) is the most abundant byproduct of the brewing process, with an estimated worldwide annual production of 39 million tons (approx. 85% of total byproducts). Due to its composition, low cost and availability throughout the year, its use as raw material in liquid biofuels production processes looks bright. Although butanol presents advantages over ethanol, a pretreatment is also required to alter the lignocellulosic structure and release the fermentable sugars. An efficient autohydrolysis pretreatment at the pH of the material or slightly acid or alkaline conditions can provide advantages over conventional pretreatments, mainly associated to lower chemicals and energy consumption. This work compares the effectiveness of autohydrolysis operating conditions (initial pH and solids load) in terms of monosaccharides liberation after enzymatic hydrolysis. The combined recovery from pretreatment and enzymatic hydrolysis for pH 1 is more than twice higher than the second best (70.4 vs 30.6%), concluding that the autohydrolysis at pH 1 is the more suitable for BSG when operating at mild conditions, achieving high monosaccharides recoveries and low inhibitors c

Presenter: **Maria Teresa GARCIA-CUBERO, University of Valladolid, Chemical Engineering & Environmental Technology, Valladolid, SPAIN**

Presenter's biography:

Associate Professor at the Chemical Engineering and Environmental Technology Departmente (University of Valladolid) since 2001. The main field of research are the obtention of liquid biofuels (etanol and butanol) from lignocellulosic agroindustrial by-products residues.

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Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## **Consortium of Simplified Kinetic Models: an Alternate Approach for Describing the Behaviour of Sugarcane Bagasse Enzymatic Hydrolysis**

Short introductive summary:

Modelling lignocellulosic biomass enzymatic hydrolysis is complex. Choosing a model, or group of models, becomes exponentially challenging, since a wide variety of formulations may be equally applicable to a system. This work focuses on the task of choosing a congregation of different semi-mechanistic Michaelis-Menten models that best fit sugarcane bagasse enzymatic hydrolysis under batch and fed-batch operations. Data were obtained from batch and fed-batch enzymatic hydrolysis of sugarcane bagasse. Experimental results were used to calculate the performance of the different groups of models. Five stoichiometric equation were considered, and in each, 4 different kinetic models were applied, pseudohomogenous and modified Michaelis-Menten with and without product inhibition. Initial results show that the models adhere well to the data. However, a great correlation between the parameters arises. Generating the necessity to evaluate new and different models and experimental techniques.

**Presenter:** **Vitor FURLONG, Federal University of São Carlos, Department of Chemical Engineering, São Carlos, BRAZIL**

Presenter's biography:

PhD student in the Federal University of São Carlos. Mainly focusing in monitoring and control of enzymatic hydrolysis of biomass.

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Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Development of a Simultaneous Saccharification and Fermentation (SSF) Process Using Alkaline Pretreated Wheat Straw

Short introductive summary:

The purpose of the study is to develop a Simultaneous Saccharification and Fermentation process where the monomeric sugars are fermented efficiently by a genetically modified yeast strain starting from wheat straw. The aim is to obtain ethanol titers and yields that are economically relevant. Therefore the wheat straw is pretreated using a low energy pretreatment with sodium hydroxide at room temperature. First a Separated Hydrolysis and Fermentation (SHF) process was developed as a standard procedure to evaluate different yeast strains and parameters during fermentation. Afterwards the acquired knowledge on the enzymatic hydrolysis and fermentation during SHF is combined to develop a SSF process.

Currently we are able to produce bioethanol starting from the crude wheat straw using an optimized pretreatment, enzymatic hydrolysis and fermentation. The obtained ethanol yields (0,42 g ethanol/g sugar or higher) and titers (6,5 v/v%) obtained after SHF are relevant for the industry with a residence time (50 hours) that is suitable for larger-scale applications. The first results of the SSF process gave promising results which show the potential to optimize this process.

Presenter: **Miet VAN DE VELDE, KU Leuven, Ghent, BELGIUM**

Presenter's biography:

In 2014 I graduated as Industrial Engineer - Biochemistry with a thesis about second generation bioethanol production. In 2015 I started my PhD "Development of a simultaneous saccharification and fermentation process for the production of bio-ethanol"

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Session reference: 3DV.4.14

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Steam Explosion Pretreatment for the Efficient Conversion of Animal Bedding into Ethanol

Short introductive summary:

Feedstock is one of the biggest contributions to production costs in 2nd generation bioethanol processes and therefore the use of low-grade biomass could be beneficial for the economic viability of these processes. This work looks particularly into ethanol production from animal bedding, a mixture of straw and manure common in some areas of Denmark.

Presenter: **Miguel SANCHIS-SEBASTIÁ, Lund Univeristy, Chemical Engineering, Lund, SWEDEN**

Presenter's biography:

I am PhD student at Lund Univeristy working with biofuels production from low-grade biomass. Before this I did a joint masters in Chemical Engineering at Universitat Politecnica de Valencia and Lund Univeristy

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Session reference: 3DV.4.15

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Fed-Batch Strategy of Enzymatic Saccharification of Lignocellulosic Biomass Maximizing Sugar Concentrations at High Solid Loadings**

Short introductive summary:

Enzymatic saccharification is an important stage in the biorefining of lignocellulosic biomass for producing biofuels or high value products. High costs of enzymatic loads (15-20% of total production costs) and low productivities are currently considered the two main aspects to be solved in order to improve the economics of this stage. Increases in high solid loadings improve sugar concentrations, but result in low yields, therefore has a negative impact in process economy. These low yields are, to a great extent, generated by heat and mass transfer problems caused by a combination of the biomass mechanical-rheological properties and reactor characteristics. A common way to solve these problems is working with a fed-batch strategy, improving sugar release, but requiring long reaction times. In this work, a strategy of increases in solid loadings (20%) of wheat straw is using with Box Benkhen design where the variables are Pre-treatment time, number of additions during fed-batch strategy, and time between additions.

**Presenter:** **Arturo SANCHEZ, Centro de Investigacion y de Estudios Avanzados del IPN, Bioenergy Futures Laboratory, Zapopan, MEXICO**

Presenter's biography:

(B.Sc. Chem. Eng., 1985; M. Chem. Eng., 1989; Ph.D., 1994). He is currently a Senior Scientist at Cinvestav-Gdl, Mexico. His research interests include advanced biofuels process engineering.

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Session reference: 3DV.4.17

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Hydrothermal Pretreatment of Lignocellulosic Biomass and its Model Compounds: Comparative Study

Short introductive summary:

We herein report the behavior of three major lignocellulosic biomass components namely lignin, hemicellulose and cellulose under hydrothermal pretreatment and its effect on enzymatic hydrolysis for glucose production. The aim is to investigate the effect of structural cross-link between the three major components by comparing the actual biomass where the components are connected to each other, with model compounds where each compounds are separated. An actual biomass was chosen and the model compound of isolated cellulose, xylan and lignin were used according to the actual biomass lignocellulose composition. To achieve the goal, the autoclave reactor was used to conduct hydrothermal pretreatment in a temperature range 150 - 250 °C for 30 minutes. To evaluate the effectiveness of the pretreatment, an enzymatic hydrolysis was done subsequently using cellulase and  $\beta$ -glucosidase at temperature 40 °C for 48 h and the glucose product was measured by HPLC. The remaining amount of cellulose was measured after the enzymatic hydrolysis. The comparison between the behavior of cellulose and the efficiency of enzymatic hydrolysis under the influence of lignin and hemicellulose presence in

Presenter: **Novi SYAFTIKA, Hiroshima University, Higashihiroshima, Hiroshima Prefecture, JAPAN**

Presenter's biography:

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Session reference: 3DV.4.21

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Cynara Cardunculus a Novel Substrate for Solid-State Production of Aspergillus Tubingensis Cellulases and Sugar Hydrolysates**

Short introductive summary:

Second generation sugars represent a versatile platform for the production of both biofuels and chemicals. Both costs and ready availability of cellulase preparations are among the major constraints in the enzymatic saccharification yet. The organism currently employed for commercial cellulase production is the ascomycete fungus *Trichoderma reesei*, which needs costly inducers to reach high-level cellulase production. Furthermore, its cellulase cocktail lacks of sufficient  $\beta$ -glucosidase; consequently, *T. reesei* cellulolytic preparations should be integrated by  $\beta$ -glucosidase rich extracts produced by other strains.

Solid state fermentation (SSF), using agro-industrial residues as substrates, offers a big potential for the containment of cellulase production cost. SSF processes occur in the absence of "free" water and simulate the natural habitat of filamentous fungi. In this research work thistle (*Cynara cardunculus*), a perennial herbaceous Mediterranean species used for the 'third-generation biorefinery' to produce chemical and bioplastic intermediates, has been evaluated as low cost substrate for cellulase and sugar hydrolysate production

Presenter: **Silvia CROGNALE, University Of Tuscia, DIBAF, Viterbo, ITALY**

Presenter's biography:

Since 2004 She is Assistant Professor at University of Tuscia Silvia in General Microbiology. She is Docent of Fermentation Biotechnology and Microbial Biotechnology

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Session reference: 3DV.4.22

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Hydrolysate from Organosolv Pretreated Beech Wood as a Substrate for Biobutanol Extractive Fermentation

Short introductive summary:

Increase in energetic demand and petroleum prices instability lead to renewed interest in biomass conversion into biofuels and biochemicals. In this context, ABE fermentation (acetone-butanol-ethanol) presents high potential in lignocellulose-based biorefinery.

In this work, hydrolyzed cellulose from organosolv pretreated beech wood was fermented by *Clostridium beijerinckii* CECT 508 and compared with synthetic P2 medium. Furthermore, in situ liquid-liquid extraction with 2-butyl-1-octanol was used to avoid end product inhibition.

Presenter: **Gemma EIBES, University of Santiago de Compostela, Department of Chemical Engineering, SANTIAGO DE COMPOSTELA, SPAIN**

Presenter's biography:

Chemical Engineering Degree, 2001

PhD in Chemical and Environmental Engineering, 2007

Currently, postdoc researcher.

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Session reference: 3DV.4.23

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Laccase Pretreatment for Agrofood Wastes Valorisation

Short introductive summary:

This work has been done in framework of the research project Waste2Fuels 'Sustainable production of next generation biofuels from waste streams' (N. 654623), funded under the European Union's research and innovation program Horizon 2020.

In this work, three Agro Food Wastes, apple residues, potato peels, and coffe silverskin, were selected based on the European availability, carbohydrate content and market price. The effectiveness of a laccase based pretreatment to improve saccharification of analysed AFWs was assessed.

Presenter: **Simona GIACOBBE, Biopox srl, Waste2Fuels project N. 654623, Scienze chimiche, ed 5B, stanza 2mb21, Naples, ITALY**

Presenter's biography:

PhD in industrial biotechnology in the field of renewable energy.

The interest/significance of my work is certified by the publication of 10 papers into peer-reviewed International Scientific Journals, and by the presentation of the obtained results at National/International Scientific congresses.

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Session reference: 3DV.4.24

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Methodology of Agitator Design for Large-Volume Bioreactors

Short introductive summary:

The large-volume tempered agitated fermenter is the heart of biotechnology treating wastes in the form of suspensions, for example during production of biofuels (biogas, bioethanol, ...). Mixing method is crucial to obtain the necessary process characteristics and then to ensure the required production and yield. Mixing process must ensure homogenization of the substrate in the agitated batch including homogeneity of the distribution of the temperature field in the batch. Moreover it is necessary to pay attention to mixing with respect to energy consumption for its own production, which affects the efficiency and profitability of the whole technological line. The mixing in these reactors can be carried out by the centrally located impeller generating one primary circulating loop in the entire mixed batch and the mixed cavern is spread to the entire volume of the batch. For the purpose of mixing in high volume tanks and reactors is more energy efficient to install more side-entry impellers in the vessel and these impellers will ensure the expansion of the circular flowing to the entire volume of the batch.

Presenter: **Tomas JIROUT, Czech Technical University in Prague, Process Engineering Dpt., Prague 6, CZECH REPUBLIC**

Presenter's biography:

Professor; Head of department - Czech Technical University in Prague, Faculty of Mechanical Engineering, Department of Process Engineering

Research and professional interests: Mixing and mixing equipment; Technology and equipment for biotechnology and biorefinery; Design of equipment

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Session reference: 3DV.4.25

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Cellulosic Ethanol Production from Tunisian Lif of Date Palm 'Phoenix Dactylifera L.'

Short introductive summary:

Lif is a byproduct generated by the date palm tree *Phoenix dactylifera* L. with an annual production of around 30460 t/year. As this material is not exploited thermochemically and biochemically, it could be a good feedstock for bioenergy recovery. Therefore, to reach this purpose it is necessary to hydrolyze enzymatically the hydrotreated lif fibers (young and old) at 220°C using a combination of two enzymes.

Presenter: **Sebastián SÁNCHEZ VILLASCLARAS, University of Jaén, Chemical Engineering, Environmental and Materials Dpt., Jaén, SPAIN**

Presenter's biography:

Sebastián Sánchez is Professor of Chemical Engineering at the University of Jaén. His research interests are in the areas 'Use of Lignocellulose materials for Biofuels Production', and 'Tertiary Treatment of Wastewater and Microalgae Biotechnology'. Currently, he is Director 'CEA OLIVE GROVE'(Spain)

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Session reference: 3DV.4.26

Subtopic: 3.5 Bio-alcohols from lignocellulosic biomass and pretreatment

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Direct Biological Methanation of the Synthesis Gas of an Allothermal Wood Gasifier**

Short introductive summary:

Methanogenic archaea are able to substitute natural gas, i.e. CH<sub>4</sub>, by metabolization of H<sub>2</sub> and CO<sub>2</sub> or CO, respectively. The presented project Ash-to-Gas aims at using syngas from thermochemically gasified biomass as the main feedstock instead of the common feed biogas and hydrogen produced by the electrolysis, leading to a broader applicability of biological methanisation.

Main research questions under evaluation are the archaeas' ability of converting CO and tars as major output of the gasification. Furthermore, the investigation focuses on the applicability of char and ash as a nutrient for the microorganisms.

This contribution will present the experimental results obtained in a continuously stirred tank methanation reactor (CSTR) at the Chair of Energy Process Engineering. The effects of CO and tars (e.g. toluene, naphthalene and acenaphthene) on the microorganisms and their convertibility will be discussed as well as the nutritional effects of fly ash of the biomass gasifier.

Presenter: **Thomas TRABOLD, Friedrich-Alexander-University of Erlangen-Nuremberg, Chair for Energy Process Engineering, Nürnberg, GERMANY**

Presenter's biography:

2009 – 2015: Studies in Chemical and Biological Engineering at FAU Erlangen – Nürnberg

Since 09/2015: Research assistant at Chair for Energy Process Engineering, FAU Erlangen – Nürnberg

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Session reference: 2DO.7.1

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Biomethanation of Surplus Electricity in Anaerobic Digesters: Identification of Parameters Determining Acetate Accumulation**

Short introductive summary:

The goal of this research is to facilitate the implementation of biomethanation of surplus electricity, by better understanding the biochemical kinetics that take place during this process.

Presenter: **Laura AGNEESSENS, Aarhus University, Department of Engineering - Manure Technology and Biogas, Aarhus, DENMARK**

Presenter's biography:

I am a PhD student at Aarhus University. The goal of the PhD is to facilitate the implementation of biomethanation of surplus electricity, by better understanding the biochemical kinetics that take place during this process.

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Session reference: 2DO.7.2

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Microbial Power-to-Gas - Techno-Economically Investigated**

Short introductive summary:

Power-to-gas is one of the technologies that gains popularity as it can have the potential to decrease the overall operating cost of the grid. However, the main drawback is still the high cost and relatively low efficiency. We performed a techno-economic analysis for a microbial power-to-gas concept in a Belgian context.

From our study we conclude that the high investment cost is mainly due to the investment cost of the electrolyser and the low number of operating hours we assumed. To improve the business case of microbial P2G the following aspects are important and should be taken into account in future research: (1) renewable electricity should be used to minimize the environmental impact and reduce the electricity costs, (2) the operating hours of the electrolyser should be as high as possible, and (3) multiple products should be produced, e.g. H<sub>2</sub>, added-value chemicals, and liquid biofuels. Therefore, we would like to stress the importance of an in-depth analysis of the possible P2G role in decarbonization of our energy systems and accordingly the need to involve policy makers in future discussions concerning P2G.

Presenter: **Ruben GUISSON, VITO - Flemish Institute Technological Research, Biomass Sustainable Transition Dpt., Mol, BELGIUM**

Presenter's biography:

Ruben Guisson MSc is an expert researcher at VITO in the fields of biomass, bioenergy and biobased economy; and Team Leader of the team 'Biomass for a Sustainable Transition'. (VITO - Flemish Institute for Technological Research – [www.vito.be](http://www.vito.be)). He promoted as a master in Applied Sciences.

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Session reference: 2DO.7.3

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Biological Methanation in a Trickle-Bed Reactor**

Short introductive summary:

Methanogenic archaea are able to produce methane by metabolization of H<sub>2</sub> and CO<sub>2</sub> or CO, and present therefore a second technological option, besides catalytic methanation, for the synthesis of biomethane or substitute natural gas (SNG). One major challenge to the implementation of this process is the supplying and dissolving the feed gases to the aqueous environment of the microorganisms. Tackling this question, the project ORBIT aims at developing a new trickle-bed reactor for biological methanation and demonstrating this technology at an existing power to gas site. This contribution will present some results regarding the numerical layout and design of the pre-pilot scale trickle-bed reactor. Furthermore, some experimental results from an existing bench-scale reactor will be shown in particular regarding.

Presenter: **Tobias WEIDLICH, FAU Erlangen-Nuremberg, Chair of Energy Process Engineering, Nuremberg, GERMANY**

Presenter's biography:

I was born in Wuerzburg, Germany and graduated from high school there in 2011.

I moved to Erlangen to study Energy Technology, finishing my M.Sc. in 2016. Since Dec. 16 I work as a Phd-student at the Chair of Energy Process Engineering. The main topic I work on is the Biological Methanation.

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Session reference: 2DO.7.4

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Strategies for Energy Recovery and Gains Associated with the Implementation of an Extra-Dry Methanization System for Treating Organic Waste from the City of Rio De Janeiro - Brazil**

Short introductive summary:

This work aims at evaluating different possibilities of biogas use and gains associated with the implementation of a demo-scale extra-dry methanization system (TMethar) in the city of Rio de Janeiro, Brazil, capable of treating 25 t.d-1 of the organic fraction of municipal solid waste (OFMSW). The TMethar is the first plant to use the garage technology in Brazil. To evaluate the potential uses of the biogas generated in the methanization system, the following main studies were carried out: i) estimation of methane production and available energy potential; ii) study of storage strategies, treatment and uses of the biogas generated; and iii) estimate of the reduction of greenhouse gas emissions due to the use of biomethane as fuel for MSW transport trucks.

Presenter: **Carlos CHERNICHARO, Universidade Federal de Minas Gerais (UFMG), Department of Sanitary and Environmental Engineering, Belo Horizonte, BRAZIL**

Presenter's biography:

Full professor at the Department of Sanitary and Environmental Engineering - Universidade Federal de Minas Gerais (UFMG), Brazil. Currently he coordinates the National Institute of Science and Technology on Sustainable Sewage Treatment Plants.

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Session reference: 2DO.7.5

Subtopic: 2.6 Anaerobic digestion for biogas production and biogas upgrading

Topic: 2. BIOMASS CONVERSION TECHNOLOGIES FOR HEATING, COOLING AND ELECTRICITY

## **Analysing the Spatial Variation of Environmental Impacts from Sugarcane Expansion in Sao Paulo State, Brazil**

Short introductive summary:

In this research we analyzed on spatio-temporal basis the environmental impacts from sugarcane expansion from 2004 to 2015 in Sao Paulo state, Brazil. Impacts from sugarcane expansion depend on local biophysical dynamics, weather conditions, geographic conditions, etc, these conditions vary extensively across the state of Sao Paulo. Therefore, an environmental impact assessment from sugar cane expansion without taking into account the spatial heterogeneity in relevant factors can lead to inadequate conclusions. The spatio-temporal approach applied in this study provides more information on the direction, magnitude and trade-offs of environmental impacts of sugar cane expansion.

Presenter: **Ivan VERA, Copernicus institute of sustainable development, Utrecht University, Utrecht, THE NETHERLANDS**

Presenter's biography:

Environmental engineer graduated from El Bosque University in Colombia and MSc in environmental sciences from Utrecht University. Research orientated to climate change and environmental impacts of land use change

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Session reference: 4DO.8.1

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY



## **GBEP Indicators to Monitor and Enhance Bioenergy Sustainability in Vietnam and Paraguay**

Short introductive summary:

Modern bioenergy production and use can have a number of positive effects, e.g. in terms of agricultural and rural development, increased energy diversity and climate change mitigation. However, bioenergy sustainability depends on the local context and on the types of production and use practices. In order to assess the environmental, social and economic sustainability of bioenergy, the Global Bioenergy Partnership (GBEP) has developed a set of 24 indicators, which have been recently implemented in Paraguay (for ethanol from sugarcane and maize, and for woody biomass) and Viet Nam (for biogas and cassava-based ethanol).

Preliminary results show that currently, in Viet Nam, ethanol production does not play an important role in replacing fossil fuels. On the other hand, biogas systems have proliferated, especially at household level, and there is still a huge untapped potential for using biogas for power generation.

In Paraguay, the sustainability of ethanol production depends mainly on the management practices in feedstock production. For woody biomass, the current wood consumption largely exceeds the net growth of managed native forest and forest plantations.

**Presenter:** **Marco COLANGELI, GBEP - FAO, Climate and Environment Dpt., Rome, ITALY**

Presenter's biography:

Mr. Colangeli works as a Bioenergy Expert in FAO since 2011. He holds a BSc in Forestry and Environmental Science, a MSc in Environmental Science for Large Urban Areas from Università degli Studi della Tuscia, and a MSc in Environmental Science and Policy from PACE University of New York.

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Session reference: 4DO.8.2

Subtopic: 4.2 Sustainability and socio-economic aspects

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Life Cycle Assessment of Wood-Energy Supply Chains in Mediterranean Forests

Short introductive summary:

This paper tackles the issue of using Life Cycle Assessment (LCA) as a decision making tool for sustainable design of wood-energy supply chains in Mediterranean area. This work is based on linking: forest protection; its sustainable use to meet local energy demand; efficiency and economic-environmental sustainability of plants. This study integrated LCA and sustainable design of supply chains, by applying it to a public forest located in Southern Italy. Environmental impacts were estimated for each phase of the supply chain, to identify the most critical processes to be improved for an increased sustainability. LCA allowed identifying the most impactful phases, as well as recognizing the most relevant environmental impact categories, by performing also an uncertainty analysis on results. It emerged that wood chipping is the most impactful phase of the designed supply chain, and Climate Change is the most impactful environmental impact category on the Areas of Protection (AoP). This scenario is more sustainable than a similar one based on fossil fuels.

Presenter: **Emanuela MELIS, University of Cagliari, Department of Mechanical, Chemical and Materials Engineering, Cagliari, ITALY**

Presenter's biography:

PhD and environmental engineer. Current position: post-doc research associate(fixed term). After research on forest biomass feedstock and sustainable design of wood-energy supply chains, she is currently working on the use of hemp in a pyrolysis plant for energy production and integrated energy systems

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 4DO.8.3

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Life Cycle Assessment of Renewable Jet Fuel from Ethanol: an Analysis from Consequential and Attributional Approaches**

Short introductive summary:

The paper aimed to estimate the GHG emissions of production and use of renewable jet fuel (RJF) from sugarcane ethanol. Three different pathways were considered in Brazilian context: first generation of ethanol, second generation from enzymatic hydrolysis of bagasse; and second generation from fermentation of bagasse syngas. The analysis was conducted in attributional and consequential perspectives. The results expressed that in all the scenarios, the GHG emissions would be at least 40% lower than fossil jet fuel. The second generation pathways got better results in attributional analysis than consequential, due to the low electricity surplus credits.

Presenter: **Rafael CAPAZ, State University of Campinas, Faculty of Mechanical Engineering (FEM), Campinas, BRAZIL**

Presenter's biography:

Environmental Engineer by the Federal University of Itajubá (2007) and Master of Science of Energy Engineering by the same institution (2009). Nowadays, he's PhD in State University of Campinas in the Energy Systems Planning Program, in co-tutelage with the Technological University of Delft

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Session reference: 4DO.8.4

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## **Energy Efficiencies, Energy Ratios, and Greenhouse Gas Emissions of Integrated and Non-Integrated Grass Refinery Systems**

Short introductive summary:

This contribution analyses the energy efficiencies, energy ratios, GHG emissions, and air pollution of integrated and non-integrated grass refinery systems. A reference system where the biorefinery is a stand-alone system, sourcing its energy needed from outside and exporting all products was compared against a combination of including an anaerobic digester and/or biogas cogeneration unit for heat and power production. The influence of allocation method on energy ratios, GHG emissions, and air pollution was analyzed. The results showed that the overall energy efficiency of the non-integrated system (85%) was lower than those of the integrated systems which ranged from 86-87% depending on system considered. All investigated biorefinery system had greater energy ratios, suggesting less energy is used in these system than produced. However, the energy ratios of integrated system were 1.7 times greater than those of the standalone system. The integrated biorefinery systems also emitted ~2 times less GHGs, and fewer air pollutants than the stand-alone system. We conclude that combining the grass pressing with other technology improves the system overall energy efficiency and reduces GHGs.

**Presenter: Sylvestre NJAKOU DJOMO, Aarhus University, Agroecology Dpt., Tjele, DENMARK**

Presenter's biography:

Researcher at Aarhus University, Department of Agroecology

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Session reference: 4DO.8.5

Subtopic: 4.3 Environmental impacts of bioenergy

Topic: 4. BIOMASS POLICIES, MARKETS AND SUSTAINABILITY

## Understanding and Predicting the Solubility of HTL Derived Bio-Crudes

Short introductive summary:

Solubility is the essential property of a substance (gas, liquid or solid) to dissolve another substance (gas, liquid or solid) and is of fundamental importance in a large number of scientific disciplines and practical applications; especially in liquid fuel refining. The solubility of a substance fundamentally depends on the physical and chemical properties. Since solubility relates to the mutual chemical interaction between any two (or more) substances, quantifying the solubility “power” of a single substance is not trivial – if even meaningful.

The Hansen Solubility Parameters (HSP) is one out of many means to quantify the solubility “power” of a single substance. The rationale behind HSP is grounded in the fact that chemically alike substances are likely soluble (such as ethanol in water), whereas chemically dissimilar substances are insoluble (e.g. hexane in water). In relation to HSP this means, if any two substances have similar (or very close) HSP they are likely soluble. Hence, HSP can be used to describe the likelihood of if e.g. bio-derived liquids will blend into fossil refinery streams.

The HSP describe the cohesive forces of a given material from three di

Presenter: **Thomas Helmer PEDERSEN, Aalborg University, Energy Technology Dpt., Aalborg, DENMARK**

Presenter's biography:

Thomas Helmer Pedersen is a researcher and assistant professor at the Department of Energy Technology, Aalborg University, Denmark. His work focuses mainly on liquid fuels production from various feedstock through hydrothermal liquefaction.

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Session reference: 3DO.9.1

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Is There a Best Way for the Hydrothermal Treatment of Moist Bio-Waste? First Experiences from a Multi-Criteria Decision-Making Approach

Short introductive summary:

A considerable part of high water containing biogenic residues does not have a proper, resource-efficient use in several European countries yet. Especially, their challenging logistics and the low energy efficiencies are identified as crucial barriers for managing these residues via conventional biomass treatment paths. Thus, hydrothermal processes (HTP) seem to be promising for the treatment of such residual streams, as for their optimal processing they actually require an input containing 70% to 90% water content. This work presents a multi-criteria decision-making (MCDM) approach for HTP based on a combination of the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and the Analytical Hierarchy Process (AHP) embedded in a step-wise, iterative procedure. The aim is to make HTP comparable to relevant alternative treatment options (reference systems) for the first time and hence facilitate the decision on which treatment path is most suitable for mobilizing wet and sludgy biogenic residues under certain requirements. The results help to reduce uncertainties, e.g. for private and public funders or other decision makers.

Presenter: **Daniel REIßMANN, Helmholtz Centre for Environmental Research - UFZ, Department of Bioenergy, Leipzig, GERMANY**

Presenter's biography:

Master of Science in Economics and Sustainability Management. Since 2016, working as Science Officer for the German Federal Environment Agency (UBA) and as PhD Student for the Helmholtz-Centre for Environmental Research (UFZ).

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Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Assessing Hydrothermal Liquefaction of Lignocellulosic Biomass, Microalgae and Sewage Sludge at Pilot Scale**

Short introductive summary:

This study presents results and experiences from the Aarhus University pilot scale HTL reactor with a capacity of up to 100 L/h, during HTL of biomass feedstocks with different structures and compositions. A discussion on energy efficiency of HTL, products pretreatment, separation and yields is included.

Presenter: **Konstantinos ANASTASAKIS, Aarhus University, Biological and Chemical Engineering, Aarhus, DENMARK**

Presenter's biography:

Konstantinos Anastasakis obtained his PhD in process engineering (bio-energy) from Leeds University (UK). Since then he has been working as a postdoc researcher at TU Delft and at Aarhus University on the fields of thermochemical biomass conversion to fuels/chemicals and large scale energy storage.

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Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **A General Reaction Network and Kinetic Model of the Hydrothermal Liquefaction of Microalga Tetraselmis Sp.**

Short introductive summary:

This work aims to study on the kinetics for the hydrothermal liquefaction(HTL) of microalgae. The HTL experiments were conducted systematically under various reaction temperature and time. A general reaction network and kinetic model were proposed for the HTL of microalgae Tetraselmis sp. In addition, a model prediction allows predicting the liquefaction product distribution as a function of temperature and time.

Presenter: **The Ky VO, Kyung Hee University, Chemical Engineering, Suwon, REPUBLIC OF KOREA**

Presenter's biography:

My name is Vo The Ky, a doctoral student at Chemical Engineering Department of Kyung Hee University, Republic of Korea

My research areas are biomass conversion, upgrading bio-oil, and catalysts.

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Session reference: 3DO.9.4

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## A Kinetic Study on Hydrothermal Liquefaction of Lignocellulosic Biomass

Short introductive summary:

Hydrothermal liquefaction is considered one of the most promising technologies for the production of high quality bio-oil. However many efforts should be done to make this process industrially feasible. A very important issue is to well understand the chemistry of the process. Very few literature works are present on this argument due to the complexity of the reactions of biomass decomposition. In this work we propose a complete kinetic model for biomass decomposition during HTL process taking into consideration the effect of temperature and biomass bio-chemical composition.

Presenter: **Benedetta DE CAPRARIIS, Sapienza University of Rome, Department of Chemical Engineering, Rome, ITALY**

Presenter's biography:

Benedetta de Caprariis is an assistant professor at the department of Chemical Engineering of Sapienza University of Rome. Her research activity concerns the biomass conversion to produce energy and bio-fuels, in particular Hydrothermal Liquefaction to produce bio-oil and gasification.

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Session reference: 3DO.9.5

Subtopic: 3.3 Biomass hydrothermal liquefaction

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Yield Reduction from Weed Competition in a Mature Crop of Giant Reed

Short introductive summary:

Weed management is an important issue in agriculture since weed competition may lead to significant reduction in crop yields. In the giant reed crop, a perennial grass grown for biomass, the effect of weed competition has been barely investigated. To the best of our knowledge there are not data on the need of weed control for giant reed crops older than two-year-old; therefore, the need of weed control in the maturity growth cycles of giant reed should be investigated. The present work is a follow-up work of a literature study, which was framed within the Project 'PROBIOCOM' (ID: RTA2012-0082-CO2). The Project was supported by the Ministry of Economy and Competitiveness of Spain and the European Regional Development Fund (ERDF).

Presenter: **Judith CANO-RUIZ, IMIDRA, Madrid, SPAIN**

Presenter's biography:

PhD student working on *Arundo donax* as energy crop.

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Session reference: 1DV.5.1

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Screening for High Water Use Efficiency from 14 Cultivars of Switchgrass (*Panicum Virgatum* L.) Under Cadmium Stress

Short introductive summary:

In order to develop bioenergy plant in heavy metal polluted area, and keep high water use efficiency (WUE) of bioenergy plants grown in cadmium (Cd) contaminated condition, 14 switchgrass (*Panicum virgatum* L.) cultivars with high biomass treated with 0 (control) and 10  $\mu\text{mol L}^{-1}$  Cd were investigated under hydroponic condition. The results showed that the instantaneous WUE ( $i\text{WUE} = P_n/E$ ) and the relative water content (RWC) in switchgrass seedling were significantly reduced after 10  $\mu\text{mol L}^{-1}$  Cd exposure. In general, the RWC Reducing Rate  $[(\text{RWC}_{\text{control}} - \text{RWC}_{\text{Cd}}) / \text{RWC}_{\text{control}} \times 100\%]$  of lowland types (Alamo, Bomaster and Kanlow) were much lower than other 11 cultivars originated in highland types. Conversely, the WUE and RWUE ( $i\text{WUE}_{\text{Cd}} / i\text{WUE}_{\text{control}} \times 100\%$ ) in lowland types were significant higher than those in highland types. The results indicated that it is possible to screen the switchgrass cultivars with high WUE as well as high capacity for Cd accumulation. It seemed that switchgrass with higher WUE and RWUE had the stronger ability to incur stomatal closure and enhance water uptake in response to Cd stress.

Presenter: **Qingsheng CAI, Nanjing Agricultural University, College of Life Sciences, Nanjing, P.R. CHINA**

Presenter's biography:

Dr. Qingsheng Cai, a professor in College of Life Sciences, Nanjing Agricultural University, China. She majored in Plant Physiology and high biomass crop sciences, having researched on developing bioenergy plants or crops in heavy metal polluted area by in vitro and in vivo regulation.

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Session reference: 1DV.5.2

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Performance of *Sida Hermaphrodita* and *Silphium Perfoliatum* in Europe: Preliminary Results

Short introductive summary:

This paper reports preliminary results on growth and biomass production of two perennial herbs, *Sida hermaphrodita* (Virginia Mallow) and *Silphium perfoliatum* (Cup Plant), tested in the frame of SidaTim project (FACCE-SURPLUS) in German, Italy, Poland and UK. *Sida* can be used for energy or as a basic compound for various material products, such as fibre products or particle board. *Silphium* can be alternative to maize for biogas production.

Presenter: **Gianni FACCIOTTO, CREA- Council for Agricultural Research & Economics, Foreste e Legno, Casale Monferrato, ITALY**

Presenter's biography:

Gianni Facciotto, since 1981 he has been working as a researcher for the former Poplar Research Institute, now Forestry and Wood Research Center of Council for agricultural research and economics (CREA), in Casale Monferrato (Italy).

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Session reference: 1DV.5.4

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Study of the Behaviour of the Implantation of *Ulmus Pumila* in Field from Phenotypically Selected Material

Short introductive summary:

*Ulmus pumila* is a woody plant that has been used as short rotation energy crop. In this work has been studied the implantation of phenotypically selected material. This material from clones, was propagated vegetative in a previous assay and selected for its predominant characteristics for the production of biomass.

The assay was carried out at IMIDRA (Alcalá de Henares, Madrid, Spain). Eight different clones with thirty individuals from each one were evaluated. Different physical parameters such height and chlorophyll were measured for three years. After this period we carried out the short clones for the evaluation of different parameters related to the characterization of the biomass production.

From the analysis of these parameters, it can be observed that there are significant differences between the different clones, such as height, diameter. Observing that each clone has a different growth.

Presenter: **M<sup>a</sup> Cruz AMORÓS SERRANO, IMIDRA, MADRID, SPAIN**

Presenter's biography:

M<sup>a</sup> Cruz is a PhD student at the University of Alcalá de Henares. Her work was in the production of plants for sustainable gardening and non-agro-food species. She is currently doing her thesis about the study of the production of biomass and its environmental effects of Elm energy crop, in IMIDRA.

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Session reference: 1DV.5.5

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Effect of Different Forms of Propagation in Arundo Donax L. after Two Years of Field Implantation

Short introductive summary:

Arundo donax L. (Giant Reed) is a perennial grass used as energy crop. It presents a lack of maturation of seeds, what makes its propagation unpractical and labor intensive. Rhizome or in vitro culture propagation have been predominantly used although these methods are unpractical and expensive. In order to facilitate its field implantation several experiments have been developed to obtain plants from vegetative multiplication of Arundo. The objective of this work is to analyze if there are differences in yield after two year field implantation of Arundo donax plants coming from different multiplication treatments.

Presenter: **Judith CANO-RUIZ, IMIDRA, Madrid, SPAIN**

Presenter's biography:

PhD student working on Arundo donax as energy crop.

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Session reference: 1DV.5.6

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## The Environmental Impact of Perennial Agriculture and Forestry on Bioenergy in Finland

Short introductive summary:

Finland has drafted a bold bioeconomy strategy. By 2030, Finland aims to be a major global leader in the production of clean energy from its biobased resources. This paper will address the environmental impact of the land use in the production of biomass (both agriculture and forestry) for bioenergy.

Presenter: **Narasinha SHURPALI, University of Eastern Finland, Biogeochemistry Research Group, Kuopio, FINLAND**

Presenter's biography:

I have a Ph. D. degree in Micrometeorology from the University of Nebraska-Lincoln, Lincoln, NE, USA. I have a strong background in environmental impact of bioenergy crops, their life cycle analysis. Currently leading an ERA-NET project on biobased clean energy with Estonia and Indian partners.

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Session reference: 1DV.5.7

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Win-Win for Farmers and Soils: Sida Hermaphrodita Cultivation on Marginal Soil

Short introductive summary:

The growing bioeconomy comes along with increasing demand for plant biomass used for bio-energy or as renewable feedstock for bio-based industries.

We present a cropping strategy for cultivation of perennial plants on marginal soils using *Sida hermaphrodita* as a promising example. By combining the perennial species with organic fertilization in an extensive cropping system, soil fertility increases over time, guaranteeing substantial biomass yield on marginal soils. Following the idea of a closed nutrient loop, we use digestate as an organic residue after biomass conversion as fertilizer and soil amendment. Intercropping with legumes fixes additional nitrogen into the plant-soil system and produces additional biomass, thus enriching the production system over time. The perennial nature of the energy crop strongly reduces the need for soil cultivation as well as pest and weed control.

We conclude that the combination of different extensive cropping strategies will enable farmers to increase fertility of marginal soils, resulting in substantial biomass yields. Further, the extensive nature of the cropping system accommodates the ecological value of marginal soils.

Presenter: **Silvia SCHREY, Juelich, GERMANY**

Presenter's biography:

Plant Scientist, Researcher on development of alternative cropping strategies for plant biomass production

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Session reference: 1DV.5.9

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES



## **Sunn Hemp, a Promising Leguminous Energy Crop as Inter-Cropping System: Preliminary Results for Spain**

Short introductive summary:

Energy crops grown to supply current and future biofuel demand should not compete with food/feed crops. The use of marginal lands to grow these crops is appointed to be a suitable solution, although it should be combined with other strategies due to the difficulty to ensure alternative crops economic viability and sustainability. One of these strategies is being evaluated under the framework of EU Project BeCool and consists in introducing energy crops as intercrops within traditional food crops rotations. This increases land available for energy crops without competing with food crops and generating ILUCs. Several alternative crop rotations are being tested within this strategy in the Spanish region of Extremadura. Preliminary results of the first year of trials are presented in this study. They will include productivity; biomass characterization and soil analysis of sunn hemp, a legume grown as energy crop with expected benefits for soil nitrogen, and of maize grown as traditional food crop. These results will constitute a first step for the determination of the viability of sunn hemp as energy inter-crop based on its productivity and its capacity to improve soil nitrogen.

Presenter: **Carlos Sixto CIRIA RAMOS, CIEMAT, Biomasa Dpt., Lubia (Soria), SPAIN**

Presenter's biography:

Agricultural Engineer at Lérida University. PhD researcher in Energy Department of Centre for Energetic Environmental and Technological Research (CIEMAT), Biomass Unit in the Centre for the Development of Renewable Energy Sources (CEDER). Research activity is close to biomass production, economic,

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Session reference: 1DV.5.10

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Evaluation of Sunn Hemp Productivity after Wheat under No Tillage Conditions

Short introductive summary:

Enhancing the multitasking of traditional agriculture is a key strategy to fulfil the Horizon 2020 targets. Sunn hemp, cultivated as an energy crop within the traditional rotations gap, represents an ambitious challenge for the coexistence of food and non-food crops without competition. The little time available for soil tillage between consecutive crops in rotation could be extended through quicker and more economical seedbed preparations. Three soil management practices were compared in this study: no-, minimum and conventional tillage. Even though the harvested dry biomass did not statistically differ among treatments, crop yield and architectural components such as emergence rate, number of plants, canopy cover, and plant height increased by 25%, 32%, 30% and 44%, respectively under no tillage conditions in comparison to conventional tillage. Moreover ramification rate was reduced by two to six times. Besides generating better performance since the emergence stage, the better biometric canopy characteristic of the no tillage treatment offer improved agronomic harvest characteristic without a yield reduction.

Presenter: **Andrea PARENTI, UNIBO, Bologna, ITALY**

Presenter's biography:

I got a master of science in agricultural sciences on 2013 at the University of Bologna and then I worked for almost 1 year in Enza Zaden Australia. I am actually a PhD student at the Department of Agricultural Sciences of the University of Bologna, working on a european project named BECOOL.

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Session reference: 1DV.5.11  
Subtopic: 1.3 Biomass crops and energy grasses  
Topic: 1. BIOMASS RESOURCES

## Improving Biomass and Ethanol Yield by Integrating Winter Cereals with Corn Stover

Short introductive summary:

Although much work has been done on the yield and quality of corn stover and winter annual cereals as stand-alone feedstocks, little information is available on the yield and quality of mixed feedstocks derived from the harvest of winter cereal crops interseeded with corn stover. This study compares the yield and quality of mixed feedstocks derived from interseeding winter cereals with corn stover, with the yield and quality of sequentially harvested corn stover (fall) and winter cereal (following spring) bioenergy feedstocks.

Presenter: **Kurt THELEN, Michigan State University, Plant, Soil & Microbial Sciences Dpt., East Lansing, USA**

Presenter's biography:

Dr. Thelen is a professor at Michigan State University, in the Plant, Soil and Microbial Sciences Department. His research program is focused on developing crop systems that increase food, feed, and energy production while safeguarding soil, air, water, and biodiversity.

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Session reference: 1DV.5.12

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Long Term Effect of Treated Sewage Sludge on Energy Crop Production

Short introductive summary:

The objective of the study was to evaluate the effect of two types of treated sewage sludge, composted with pruning wastes (CP) and thermally dried (ST) on the production of ten woody perennials species for energy purposes.

Presenter: **M<sup>a</sup> Cruz AMORÓS SERRANO, IMIDRA, MADRID, SPAIN**

Presenter's biography:

M<sup>a</sup> Cruz is a PhD student at the University of Alcalá de Henares. Her work was in the production of plants for sustainable gardening and non-agro-food species. She is currently doing her thesis about the study of the production of biomass and its environmental effects of Elm energy crop, in IMIDRA.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 1DV.5.13

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## **PANACEA - A Thematic Network to Design the Penetration Path of Non-Food Crops into European Agriculture**

Short introductive summary:

The abstract is referring to a new research project that started in November 2017 and will be funded by HORIZON 2020. PANACEA project aims to design the penetration path of non-food crops into EU agriculture producing feed stocks for bio-based products and materials to feed EU's circular economy.

Presenter: **Efthymia ALEXOPOULOU, Center for Renewable Energy Sources, Biomass Dpt., Pikermi Attikis, GREECE**

Presenter's biography:

She is an agriculture engineer graduated from the Agricultural University in Athens (AUA) with PhD on the "Adaptability and biomass productivity of the non-food crop Kenaf in Greece". She is responsible for Energy Crops Unit in Biomass Department of Center for Renewable Energy Sources.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

Co-authors:

E. Alexopoulou, CRES, PIKERMI, GREECE

Session reference: 1DV.5.16

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## **Biomass Yield and Morphological Features of 26 Genotypes Perennial Industrial Crops**

Short introductive summary:

The diversity of perennial industrial crops (PIC) requires proper selection of species and cultivars with high resistance to weather and habitat conditions and high biomass yield, which will affect the profitability of their production. The aim of the study included an assessment of resistance to environmental conditions, survival rate, morphological features and biomass yield of 26 genotypes of PIC harvested in successive annual harvest cycles. The diversity PIC gave good possibility to obtain straw, semi-woody or woody biomass in annual harvest cycles. Short rotation woody crops were the most resistant to environmental conditions whereas grasses and some herbaceous genotypes were the most prone to lodging. The highest yield of biomass in the experiment was obtained from the three new willow varieties. Whereas *Sida hermaphrodita*, *Helianthus salicifolius* and *Miscanthus sacchariflorus* also gave very high biomass yield.

Presenter: **Mariusz STOLARSKI, University of Warmia and Mazury in Olsztyn, 739-30-33-097, OLSZTYN, POLAND**

Presenter's biography:

Prof. Stolarski is full professor and works at the University of Warmia and Mazury in Olsztyn. He carries out research in the area of cultivation, logistics, productivity, economic and energy efficiency analysis, biomass features and usability of alternative crops for industry and energy.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 1DV.5.17

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Seeds and Oil Yield of *Crambe Abyssinica* Genotypes Cultivated in Poland

Short introductive summary:

*Crambe* (*Crambe abyssinica* Hochst ex R.E. Fries) is a oleaginous crop from the Brassicaceae family. Due to its reasonably high oil content (and valuable compositions of fatty acids) is an attractive feedstock for modern biorefineries. The aim of this research was to assess seeds and oil yielding potential of 2 varieties and 8 new *crambe* genotypes cultivated in the climate of the north-east Poland. Two years results from the field trial, located in the continental climate of Europe, show high productivity potential of new genotypes of *Crambe abyssinica*, both for seed and oil yields.

Presenter: **Michal KRZYZANIAK, University of Warmia and Mazury in Olsztyn, 7393033097, OLSZTYN, POLAND**

Presenter's biography:

Dr. Krzyzaniak work as assistant professor at University of Warmia and Mazury in Olsztyn (PhD in agronomy, specialisation agrienergy). He runs own small research and consulting company as well.

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Session reference: 1DV.5.18

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## **Screening Trials on Two New Important Non-Food Oil Crops (Camelina and Crambe) for the European Biobased Industry**

Short introductive summary:

This abstract is presented part of the field trials that have been carried out in H2020 project entitled COSMOS. It is presenting the results of two field trials that had been carried out for three subsequent years each on two important new oil crops namely camelina and crambe.

Presenter: **Efthymia ALEXOPOULOU, Center for Renewable Energy Sources, Biomass Dpt., Pikermi Attikis, GREECE**

Presenter's biography:

She is an agriculture engineer graduated from the Agricultural University in Athens (AUA) with PhD on the "Adaptability and biomass productivity of the non-food crop Kenaf in Greece". She is responsible for Energy Crops Unit in Biomass Department of Center for Renewable Energy Sources.

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Session reference: 1DV.5.19

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES



## **Miscanthus as a Model Crop for the Bioeconomy - Can Novel Genotypes for Green Harvest Open Up New Markets?**

Short introductive summary:

Studies showed that the environmental impact of biogas production can be reduced by shifting crop production from maize to perennial, low-input miscanthus. Biomass of novel miscanthus genotypes can have a higher quality for anaerobic digestion (less lignified) than *Miscanthus x giganteus*, but it is not clear if their yields are stable over several years under a green-harvest regime.

The objective of this study was to assess yield, yield stability and biomass quality for anaerobic digestion of 3 novel miscanthus genotypes under 3 green-harvest regimes alongside switchgrass and maize. The novel miscanthus genotypes showed a higher over-year yield-stability compared to *Miscanthus x giganteus* at all green-cut harvest regimes and OPM 77 was out-yielding maize each year. In this study, anaerobic digestion was assessed as an example utilization option, since anaerobic digestion is as a potential new market to introduce miscanthus as a sustainable crop into Europe's Agriculture/Bioeconomy. The long-term goal is to establish miscanthus as sustainable resource crop for modern biorefinery concepts, thereby green biomass opens up a range of new valorization options.

Presenter: **Andreas KIESEL, University of Hohenheim, Biobased Products and Energy Crops, Stuttgart, GERMANY**

Presenter's biography:

Andreas Kiesel is Scientist at the Institute of Crop Science, Dpt. Biobased Products and Energy Crops. His field of research is novel application options of miscanthus. He started his career in the EU project OPTIMISC (289159) and is now coordinating the H2020 BBI Demo project GRACE (745012).

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Session reference: 1DV.5.20

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Perennial Grasses as Sources For Bioenergy and Bio-Products

Short introductive summary:

This abstract is focus on perennial grasses as valuable sources for bioenergy and bioproducts. This work in its final version will present long term yield data on three perennial grasses (switchgrass, miscanthus and giant reed) grown on marginal lands. Currently this reaserch is being funded by MAGIC & BECOOL.

Presenter: **Efthymia ALEXOPOULOU, Center for Renewable Energy Sources, Biomass Dpt., Pikermi Attikis, GREECE**

Presenter's biography:

She is an agriculture engineer grantuated from the Agricultural University in Athens (AUA) with PhD on the "Adaptability and biomass productivity of the non-food crop Kenaf in Greece". She is responsible for Energy Crops Unit in Biomass Department of Center for Renewable Energy Sources.

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Session reference: 1DV.5.21

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Hemp Seed Mechanical Harvesting Efficiency Analysis

Short introductive summary:

Mechanical harvesting of hemp seeds is performed using machines developed for other grain crops in order to allow an easier insertion of hemp cultivation into consolidated production area trying to avoid further purchase of complex and expensive machinery on the territory. On the other hand, it involves the use of machines with low harvesting efficiency such as combine harvesters used for grain harvesting and adapted to hemp seeds. The hemp plants are considerably different from the cereal grain plant having a biomass production (straws) two to three times bigger than grain in weight. Hemp seed is harvested when the seed begin to scatter. Furthermore, hemp straws have a very strong fiber and a friable shive. All these factors combined, lead to a complex setting of the combine harvester. In this paper, harvesting tests were performed in order to analyze hemp seeds harvesting efficiency of conventional combine harvester, in cereal grain setting without specific heads and accessory. The qualitative aspects and grain losses are examined to identify the best harvest line as a function of main crop parameters.

Presenter: **Alberto ASSIRELLI, CREA - Research center for engineering and agro-food processing, Monterotondo - RM, ITALY**

Presenter's biography:

Dr. Alberto Assirelli has a PhD in Agricultural Engineering in 1997 and start working in the Department of Economics and Agricultural Engineering at the University of Bologna, continuing his works in other public and private research centers.

Researcher in the Agricultural Engineering Unit (CREA-ING) of the Agricultural Research and Experimental Council (CREA), in Monterotondo (Roma).

Author of more than 400 publications in the fields of agricultural mechanization with particular reference to the development and testing of new machinery for food, feed and energy crops.

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Session reference: 1DV.5.22

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## **Can Marginal Lands Help to Secure the Biomass Demand of the European Bioeconomy? Performance of Miscanthus on Contaminated Arable Land**

Short introductive summary:

The aim of the presented study was to assess the cultivation potential of novel Miscanthus seeds-based hybrids on heavy metal contaminated arable land, alongside M. × giganteus propagated from rhizomes. The preliminary results show high potential in the cultivation of Miscanthus seed-based hybrids at heavy metal contaminated arable land. Obtained biomass yield was comparable with the yield of M × giganteus and did not differ from the results from non-contaminated sites. Also, differences in heavy metal uptake were found between the tested hybrids as well as M. × giganteus.

Presenter: **Jacek KRZYŻAK, Institute for Ecology of Industrial Areas, Katowice, POLAND**

Presenter's biography:

Scientist at the Institute for Ecology of Industrial Areas (IETU). I am working on the phytoremediation of heavy metal contaminated land and the use of energy crop from such land as a local energy carrier.

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Session reference: 1DV.5.24

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Function of Laccases and Related Transcription Factors in Lignin Biosynthesis in Miscanthus

Short introductive summary:

Our research reveals the relationship between lignin biosynthesis and laccase and related TFs in an energy crop - Miscanthus, aiming at facilitating breeding efforts towards tailored biomass.

Presenter: **Feng HE, Centre for Organismal Studies, Heidelberg University, Heidelberg, GERMANY**

Presenter's biography:

Feng is now a PhD student in Heidelberg University in a bioeconomy graduate program. He got his master degree in Huazhong University of Science and Technology in China, focused on biomass refinery and pollutant degradation with fungi. His PhD project is about the biosynthesis of lignin in Miscanthus

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 1DV.5.25

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## **Gasification Biochar Used as Soil Conditioner Positively Affects Physical Properties Known to Control Crop Yield And Nitrogen Leaching on Coarse Sandy Soil**

Short introductive summary:

We investigated effects of adding different biochars in amounts up to 4 wt% to a common Danish coarse sandy soil. Fine-grained biochars produced from straw and other materials as by-products in a low temperature gasification process greatly improved soil physical properties known to limit fertility of the soil type, i.e. poor water retention and large mechanical resistance to root growth. Plant available water capacity was greatly increased and the soil became easier to compress.

Presenter: **Line VINTHER HANSEN, University of Copenhagen, Copenhagen, DENMARK**

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Session reference: 1DV.5.27

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## **The Effect of Digestion Fertilization on the Methane Potential of Selected Plants Cultivated for Energy Purposes**

Short introductive summary:

The Kiotio protocol sets binding quantitative targets to reduce and reduce greenhouse gases. Dissemination of the use of renewable energy sources is one of the measures supporting counteracting climate change. In addition, the use of biomass may increase the energy security of the region.

The aim of the study was to compare the influence of different nitrogen fertilization systems (mineral N-1, mineral and digestate N-2, and digestate N-3) on the selected parameters of three plants: triticulum, sorghum and maize. Silages from those biogas plants were used to examine their methane potential.

Presenter: **Agata WITOROZEC, IUNG-PIB, Department of Systems and Economics of Crop Production, Pulawy, POLAND**

Presenter's biography:

I am a PhD student in Department of Systems and Economics of Crop Production in Institute of Soil Science and Plant Cultivation - State Research Institute in Pulawy (Poland). My work is concerning the possibilities for the cultivation and use of plants for biomethane production.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 1DV.5.29

Subtopic: 1.3 Biomass crops and energy grasses

Topic: 1. BIOMASS RESOURCES

## Mass and Energy Balances of Commercial Black Pellet Facilities: an IBTC Study

Short introductive summary:

The International Biomass Torrefaction Council (IBTC) commissioned a study to primarily provide insight in the mass and energy balances of different torrefaction processes. The objective of this study was to aggregate actual production figures based on input collected from large-scale plants. A consortium of ECN, CENER and UMEA prepared an online survey that safeguarded anonymous participation, and was also suitable to collect data from white wood pellets as well as steam explosion pellet production facilities. An input file was prepared in which all data was normalised to 1 ton/h output to mask the actual production capacity. The survey went online in December 2016 and a large number of torrefaction and steam explosion technology developers were approached to participate, as well as white wood pellet technology suppliers and producers.

Presenter: **Pavlina NANOU, Energy Research Centre of the Netherlands, Biomass and Energy Efficiency Dpt., Petten, THE NETHERLANDS**

Presenter's biography:

Pavlina Nanou has 15 years of research experience on biomass conversion technologies. She has a chemical engineering background and since 2013 she is working as a researcher and project manager on dry and wet torrefaction technologies at ECN.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 3DV.6.2

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## Low-grade Biomass Upgrading by Washing and Torrefaction: Lab and Pilot-Scale Results

Short introductive summary:

Dr. Pedro Abelha has a degree in Chemical Engineering (1997) and a PhD (2005) on pollutant emissions reduction during co-combustion of biomass and coal. He developed research work for 20 years in bioenergy area, mainly related to efficient energy use of biomass and waste materials in thermochemical processes. He has participated in about 20 European and national projects. He has 23 papers published in recognized international journals with peer review, 30 papers presented at scientific international conferences and three book chapters.

Presenter: **Pedro ABELHA, Energy research Centre of the Netherlands, Petten, THE NETHERLANDS**

Presenter's biography:

Dr. Pedro Abelha has a degree in Chemical Engineering (1997) and he concluded a PhD (2005) on pollutant emissions reduction during co-combustion of biomass and coal. He developed research work for 20 years in bioenergy area, mainly related to efficient energy use of biomass and waste materials.

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Session reference: 3DV.6.3

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

## Assessing the Feasibility of Hydrothermal Carbonisation (HTC) for the Treatment of Waste Biomass

Short introductive summary:

This work studies the application of HTC as a working waste treatment through the means of a flexible process model. A simple HTC plant has been simulated under a range of temperatures, residence times and pH conditions to investigate the effects on hydrochar yield, hydrochar energy content, plant efficiency and CO<sub>2</sub> emissions. Overall the model gave promising results in terms of energy recovery of the hydrochar and plant energy efficiency. The process model will be developed further, ultimately providing data for a comprehensive life cycle assessment of the HTC process.

Presenter: **Sarah FARTHING, University of Nottingham, Nottingham, UNITED KINGDOM**

Presenter's biography:

PhD researcher at The University of Nottingham studying the feasibility of hydrothermal carbonisation for the treatment of waste biomass. Previously received a MEng from the University of Nottingham in 2015.

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Session reference: 3DV.6.4

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

## The Effect of Hydrothermal Carbonisation on the Char Reactivity of Biomass

Short introductive summary:

The abstract details a study into the effect of hydrothermal carbonisation (HTC) on the char reactivity of biomass. The char reactivity of biocoal produced in HTC is compared to that of raw biomass, torrefied wood, acid-leached olive cake, and high-volatile bituminous coal.

Robert Stirling completed his Master's degree in Chemistry in 2014 from the University of Edinburgh, UK. He is currently working towards achieving an Engineering Doctorate at the Centre for Doctoral Training in Carbon Capture and Storage and Cleaner Fossil Energy (University of Nottingham).

Presenter: **Robert STIRLING, University of Nottingham, Chemical and Environmental Engineering, Nottingham, UNITED KINGDOM**

Presenter's biography:

Robert Stirling completed his Master's degree in Chemistry in 2014 from the University of Edinburgh, UK. He is currently working towards achieving an Engineering Doctorate at the Centre for Doctoral Training in Carbon Capture and Storage and Cleaner Fossil Energy (University of Nottingham).

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Session reference: 3DV.6.5

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Advanced Bioenergy Carriers to Support a More Flexible Application of Biomass

Short introductive summary:

Within the renewable energy resources portfolio bioenergy carriers are the most flexible and used in different energy sectors: heating / cooling, power provision or transportation fuel supply. While the bioenergy provision from energy crops is limited, there is still a reasonable unused potential from residues and waste. But improved qualities are necessary with regard to energy density, storability, fuel content, flexible application and related emissions. Thermally treated and densified solid biofuels as well as biochemically treated gaseous biofuels can be generated with reasonable effort and are suitable for utilising the available still unused waste and residual streams potentials. Those advanced bioenergy carriers can support the energy transition significantly, but need support for market introduction.

Presenter: **Eric BILLIG, Umweltforschungszentrum UFZ, Bioenergie Dpt., Leipzig, GERMANY**

Presenter's biography:

Eric Billig studied environmental engineering in Berlin. He first started to work at the KIT in Karlsruhe and was responsible for experiments based on the pyrolysis of biomass. Shortly after that he changed to the DBFZ (German Biomass Research Center) in Leipzig, where he works since 2010 as research associate. Since 2012 he is dedicated to his PhD thesis which deals with the evaluation of biomethane and bio-SNG production plants.

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Session reference: 3DV.6.6

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Enabling the Biocarbon Value Chains for Energy and Metallurgical Industries

Short introductory summary:

For four years (2014-17), a competence building project (BioCarb+) on the biocarbon value chain for energy and metallurgical industries has been running in Norway. Value chains, from the resource side to the end user side, have been studied, aiming at improvement along the value chains to increase their sustainability. The ultimate goal is to enable the use of Norwegian national forest resources for production of biocarbon of various qualities, for different end uses. In this work the value chains and main findings of the project are presented, and recommendations are given.

Presenter: **Øyvind SKREIBERG, SINTEF Energy Research, Thermal Energy Dpt., Trondheim, NORWAY**

Presenter's biography:

Dr. Øyvind Skreiberg is Chief Scientist within stationary bioenergy at SINTEF in Trondheim, Norway, having 25 years of broad bioenergy experience, contributed to more than 500 scientific publications, presentations and reports and representing Norway since 1998 in IEA Task 32.

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Session reference: 3DV.6.7

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

## Characterization of Biocarbon Produced under Different Carbonization Conditions

Short introductive summary:

A comparison between the properties of biocarbon produced from carbonization of spruce wood and its forest residues at different heating rates and pressures has been performed. Low heating rate and atmospheric pressure carbonization experiments were conducted in a fixed bed reactor, while a flash carbonization reactor was used for preparing char at pressurized conditions and higher heating rate. The biocarbon samples were characterized by proximate and ultimate analyses. The morphological and microchemistry differences of biocarbon samples produced under the different carbonization conditions were analyzed by scanning electron microscopy combined with energy dispersive X-ray analysis (SEM-EDX). X-ray diffraction (XRD) and Fourier-transform infrared spectroscopy (FTIR) were used to investigate the degree of char structure order and functional groups. The results obtained from the different analytical techniques were summarized and compared to generate an overview of the chemical and physical properties of the different biocarbon samples studied.

Presenter: **Liang WANG, SINTEF Energy Research, Thermal Energy Dpt., Trondheim, NORWAY**

Presenter's biography:

Liang Wang is a research scientist at SINTEF Energy Research in Trondheim Norway. His research focuses on thermal conversion and utilization of biomass and wastes for renewable energy and green fuel production and sustainable metal production processes.

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Session reference: 3DV.6.8

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## A Solar Driven Thermochemical Process for the Production of Biofuel

Short introductive summary:

The project aims to investigate a novel approach of using concentrated solar energy for the thermochemical conversion of biomass for the use in rural and remote areas of developing countries. Feedstock and technologies will be selected based on the outcome of a survey conducted within rural Uganda. The overall aim of the project is to design, construct and test a thermochemical 'device' for the production of biofuel which utilises concentrated solar energy.

Presenter: **Toby GREEN, University of Leeds, School of Process and Chemical Engineering, Leeds, UNITED KINGDOM**

Presenter's biography:

I am currently a PhD student at the University of Leeds within the School of Chemical and Process Engineering, taking part in the Bioenergy CDT programme. I am in the second year of the 4 year programme completing. Thesis title: 'Solar Driven Thermochemical Production of Biofuel'.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 3DV.6.10

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## Constant-Volume Carbonization of Biomass

Short introductive summary:

Constant volume carbonization of biomass is a largely undeveloped area of research. Early results have shown high fixed carbon yields from biomass resources. The effects of independent variables (temperature, initial reactor pressure, feedstock specific volume, fuel particle size, fuel moisture content, etc.) on the process performance variables (biocarbon yield, fixed carbon yield, fixed carbon content, biocarbon reactivity, biocarbon morphology, etc.) will be reported.

Presenter: **Scott TURN, University of Hawaii, Hawaii Natural Energy Institute, Honolulu, USA**

Presenter's biography:

Scott Turn is a Researcher on the faculty of the Hawaii Natural Energy Institute at the University of Hawaii. Research interests include biomass resource assessment, feedstock processing and characterization, thermochemical conversion, hot gas cleaning, fuel reforming, and biofuel properties.

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Session reference: 3DV.6.13

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS



## **Continuous Torrefaction of Virginia Mallow Under Carbon Dioxide Atmosphere in a Screw Conveyor Reactor**

Short introductive summary:

It was found that both the heating value and carbon, and fixed carbon contents of torrefied biomass increased while the moisture content decreased.

Carbon content increased from 45,9% to 58,6% as well as HHV increased from 17,2 MJ/kg to 23,6 MJ/kg.

This investigation suggested that continuous torrefaction of Virginia Mallow provides good quality feedstock for energy use.

Presenter: **Stanislaw SZWAJA, Czestochowa University of Technology, Czestochowa, POLAND**

Presenter's biography:

Dr. Stanislaw Szwaja received his PhD from Czestochowa University of Technology in 1994, where he works as the associate professor. His research work has been concerning various problems on energy conversion, its impact on natural environment, energy storage and savings.

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Session reference: 3DV.6.14

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS,  
CHEMICALS AND MATERIALS

## Plant Origin Biomass Torrefaction Process. Investigation of Exothermic Process during Torrefaction

Short introductive summary:

One of modern energy sector priority tasks is the complete development of biomass utilization as solid fuel. The importance of this task is determined by necessity of energy sector environmental load reducing. Current paper presents JIHT RAS progress in investigation of the biofuel preliminary treatment technology - low-temperature pyrolysis (torrefaction). Torrefaction makes possible the obtaining of a hydrophobic high-energy product that is close to fossil coal in terms of basic thermo-technical parameters. However, the implementation of the process is accompanied by a number of difficulties associated with the nature of the processed raw materials, such as self-heating process occurring during thermal decomposition. In JIHT RAS there was created a torrefaction pilot unit to study thermal effects rational using.

Presenter: **George SYTCHEV, Joint Institute for High Temperatures RAS, Laboratory of Distributed Energy Generation, Moscow, RUSSIAN FEDERATION**

Presenter's biography:

Graduated from BMSTU (Bauman Moscow State Technical University) with a degree in Renewable Energy Sources in 2012. Since 2011 to present days on stab in JIHT RAS. The main direction of research activity is renewable energy sources using, namely, plant origin biomass energy utilization.

*Biographies and Short introductive summaries are supplied directly by presenters and are published here unedited*

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Session reference: 3DV.6.15

Subtopic: 3.1 Production of thermally treated solid biofuels

Topic: 3. BIOMASS CONVERSION TECHNOLOGIES FOR LIQUID AND GASEOUS FUELS, CHEMICALS AND MATERIALS

## **Sustainability and governance of bioenergy supply chains**

*Tuesday 15<sup>th</sup> May, 12:30 - 15:30*

Short introductory summary:

Sustainability of liquid and solid biofuels production is under continued scrutiny, including topics such as iLUC, food vs. fuel, forest carbon accounting and sustainable forest management principles. Sustainability criteria and metrics differ between feedstock and final end use (road transport vs. heat & power, size of end-use, no criteria for aviation, shipping & materials yet).

At the same time, the public debate on bioenergy is heated, partly due to different views on governance, and the partial or perceived failure of systems to ensure the sustainability of bioenergy supply chains. Obviously, definitions of 'sustainable bioenergy' also depend on different views and perceptions of stakeholders, both within and outside the value chains, and this may confuse the discussion.

To address the respective challenges, the IEA Bioenergy inter-task project on "Measuring, governing and gaining support for sustainable bioenergy supply chains" is pursuing three main objectives:

1. To provide an overview and examples of calculation methods & tools to assess the sustainability of various biomass and bioenergy supply chains and discuss needs, possibilities and limitations of global, uniform/harmonized framework.
2. To compare and assess the legitimacy, including effectiveness and efficiency of a variety of approaches on how to govern and verify sustainability of biomass and bioenergy supply chains in different conditions.
3. To understand the positions and underlying motivations of stakeholder groups relative to their perceptions of bioenergy and inform dialogues/discussions to avoid misconceptions and gain trust in bioenergy.

This project was started in mid-2016, and under the three objectives, a multitude of studies have been initiated, focusing largely on agriculture, forestry and biogas. These have now yielded results to be shared and discussed with participants of EUBCE 2018.

1. Given the ongoing discussions on sustainability and governance of bioenergy supply chains in the RED-II negotiations, the aims of this side event are two-fold:
2. To share project results of the work carried out on governance and stakeholder involvement with an audience from industry, policy, science, and civil society.

To discuss existing and new approaches for governance – the way forward.

Organized by:

**IEA Bioenergy**

## **SEEMLA Sustainable exploitation of biomass for bioenergy from marginal lands in Europe**

*Tuesday 15<sup>th</sup> May, 13:15 – 18:30*

Short introductive summary:

The main objective of the H2020 funded EU project SEEMLA (acronym for Sustainable Exploitation of Biomass for Bioenergy from Marginal Lands in Europe) is the establishment of suitable innovative land-use strategies for a sustainable production of plant-based energy on marginal lands while improving general ecosystem services. The use of marginal lands (MagL) could contribute to the mitigation of the fast growing competition between traditional food production and production of renewable bio-resources on arable lands.

SEEMLA focuses on the promotion of re-conversion of MagLs for the production of bioenergy through the direct involvement of farmers and forester, the strengthening of local small-scale supply chains, and the promotion of plantations of bioenergy plants on MagLs. Life cycle assessment is performed in order to analyse possible impacts on the environment and a soil quality rating tool is applied to define and classify MagL. Suitable perennial and woody bioenergy crops are selected to be grown in pilot areas in the partner countries Ukraine, Greece and Germany: the SEEMLA approach will be developed taking into account sustainability parameters, biomass productivity, economic balance, technical and financial resources for biomass exploitation, plant characteristics, and accessibility.

Furthermore, during the whole project, regional stakeholders will be considered to refine the approach and to increase awareness of local supply chain actors.

SEEMLA is expected to contribute to an increasing demand of biomass for bioenergy production in order to meet the 2020 targets and beyond.

For more information: [www.seemla.eu](http://www.seemla.eu)

Project n°691874 – Horizon2020

Organized by:

**Legambiente**

## **Bioenergy towards 2030**

### **Needs and opportunities for research and innovation to meet the targets for the next decade**

*Wednesday 16<sup>th</sup> May, 13:30 - 16:45*

Short introductory summary:

The EU is advancing towards its 2020 and 2030 energy and climate targets. It also continues to build an Energy Union with secure, affordable and climate-friendly energy. In 2018, a series of EU policy initiatives will shape the post 2020 environment for bioenergy and renewables in general. Besides the negotiations on the Renewable Energy Directive, the plan for the implementation of Action 8 (Renewable fuels and bioenergy) of the EU Strategic Technology Plan will be defined. In addition, the preparatory work for the elaboration of the post Horizon 2020 Research and Innovation programme is progressing, and a first proposal for FP9 is expected in the first half of the year. All together these initiatives will contribute to setting the context for bioenergy in the next decade.

In the first part, the event will focus on the role of bioenergy in the scenario of the EU Energy Union and what should be the priorities in research and innovation to meet the targets for bioenergy included in the SET-Plan. In the second part, the event will inform about the current status of the discussion for the planning of the new EU programme for research and innovation related to renewable energy (FP9). A final panel and open discussion will be organized, to collect expert's views and recommendations for bioenergy related topics and actions in the FP9.

Organized by:

**ETIP Bioenergy**

**ETA-Florence Renewable Energies**

## **Production and utilisation options for Solid Recovered Fuels**

*Thursday 17<sup>th</sup> May, 09:00 - 16:00*

Short introductory summary:

In the circular economy, the production and utilisation of Solid Recovered Fuel (SRF) is increasingly recognised as an important element in waste management practises. SRF is produced from non-hazardous waste from biological and fossil origins and can therefore be regarded as a partly renewable fuel. It usually has undergone a sorting process and therefore delivers a fuel that meets strict quality requirements. Narrow specifications of the fuel allow for more targeted end user applications, thereby benefitting the economic and environmental performance.

Recently there have been several new experiences in the production and use of SRF. This workshop provides and update in the potential market volumes of SRF, policy developments and experiences of market actors involved.

Organized by:

**IEA Bioenergy - Task 32: Biomass Combustion and Cofiring, Task 33: Gasification of Biomass and Waste, Task 36: Integrating Energy Recovery into Solid Waste Management Systems**  
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